



**CLEAN DEVELOPMENT MECHANISM  
PROJECT DESIGN DOCUMENT FORM (CDM-PDD)  
Version 03 - in effect as of: 28 July 2006**

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**SECTION A. General description of project activity****A.1 Title of the project activity:**

Duerping Coal Mine Methane Utilization Project

Final version 04.09

Completion date November 4<sup>th</sup>, 2008

| Version History  | Changes                                     | Date                             |
|------------------|---|----------------------------------|
| Version Val01    | First Draft and 1 <sup>st</sup> GSP Version | Nov 20, 2006                     |
| Version Val02    | DOE comments                                | April 27, 2007                   |
| Version 03       | DOE comments                                | Nov 19, 2007                     |
| Version Val04.01 | 2nd GSP                                     | Nov 26, 2007                     |
| Version 04.02    | Final Draft                                 | March 19, 2008                   |
| Version 04.03    | Final                                       | June 06, 2008                    |
| Version 4.04     | Final                                       | June 25, 2008                    |
| Version 4.05     | Final                                       | June 26, 2008                    |
| Version 4.06     | Final                                       | June 27, 2008                    |
| Version 4.07     | Final                                       | June 29, 2008                    |
| Version 4.08     | Final, to address completeness check        | September 1 <sup>st</sup> , 2008 |
| Version 4.09     | Final, to address request for review        | Nov 4 <sup>th</sup> , 2008       |

**A.2. Description of the project activity:**

Shanxi Coking Coal Group Company Ltd. is China's sixth largest coal producer. The company has a mining area of 2,604 sq km covering parts of the Xishan, Huoxi and Hedong coal fields in Shanxi Province. The total proven reserves are 22 billion tonnes of coal, across 22 operational mines producing 60 million tonnes in 2005. Duerping Coal Mine of the Shanxi Coking Coal Group is situated in the Xishan coalfield located near the city of Taiyuan. It was formerly a key State-Owned, centrally managed coal mine. Duerping has a coal production capacity of 5 million tonnes and produced 4.5 million tonnes in 2005. It has reserves of approximately 700 million tonnes of coal and an operational lifetime of around 50 years, well in excess of the lifetime of the proposed project activity, and is a major source of greenhouse gas emissions.

The current total relative emission of the mine is 17.7m<sup>3</sup> of methane per tonne of coal mined. Future workings are expected to be increasingly gassy as mining gets deeper. Of the gas emitted by the underground mining operations, at present, about 15% is captured by methane drainage and 85% is exhausted to the atmosphere as ventilation air methane (VAM). During the course of the project the mine anticipates raising the capture efficiency substantially with a possible target of 40%. A graph showing the current coal mine methane (CMM) emissions is presented in Annex 3.

Duerping Coal Mine has installed a new gas extraction station and an additional ventilation shaft to facilitate expanded coal production and a concomitant increase in gas flows at Beishigou Pumping



Station. Following the proposal of a CDM Project in 2005, a feasibility study was prepared by Shanxi Electric Power Exploration & Design Institute.

The feasibility study estimates that under current conditions there will be sufficient gas to generate up to 12 MW of electrical power. In view of expected improvements in capture efficiency and increased production, the available amount of gas may be higher than currently predicted.

The project activity's primary aim is utilization of Coal Mine Methane (CMM) that would have been vented in the absence of the project activity. The project activity does not involve the capture of methane, but only its utilization. The capture of methane is already taking place under the baseline scenario.

There will be times when installed generation capacity cannot cope with the quality or volume of gas. Gas of concentration less than the permitted minimum for utilisation (currently <30%) but higher than 25% will be flared and gas less than 25% (i.e. low quality gas) will be vented in accordance with the Chinese Mining Regulations available in the *Coalmine Safety Regulation* (11/2005) item 148.1) and the *Coalmine Methane Treatment and Utilization Macro Plan* published by National Development and Reform Committee (NDRC) in June 2005. Vented gas is not monitored for emission reductions. Approximately 20% of the gas is expected to be flared. The venting of gas is consistent with the methodology because the project activity is not capturing the gas, only utilizing it. The gas is captured under the baseline scenario. Peaks of gas flow which exceed generation capacity, brought about by normal mining operations, may also result in the flaring of methane concentrations in excess of 30%.

Waste heat from the exhaust of the generators will be utilized to provide heat to warm the intake air of the mine during the winter months. The waste heat will displace coal currently used in two coal-fired mine ventilation air heaters that currently provide in the region of 54 TJ of heat energy. These boilers were installed in 2006 and have a remaining technical life in excess of 15 years, well beyond the crediting period of the project. The combined heating duty of the boilers is 4.2MW and the heating season is 5 to 6 months. Waste heat from the generators will satisfy some or all of this heating duty for those 5 to 6 months subject to CMM availability and mechanical performance of the generators.

Under a parallel initiative (not part of the CDM project activity), international gas drainage experts are working with mine staff to improve gas drainage capture efficiency, stability of gas quality and mine safety.

There is currently no legislation requiring the treatment of CMM in China, which is usually released directly to atmosphere. Recently, legislation has been introduced to require improved methane drainage for safety purposes, but this does not extend to mandatory utilisation of the methane. Currently, methane use happens opportunistically within the coal mining sector, and is not practiced at the Duerping Coal Mine.

The project activity will install the necessary pipe-work, monitoring, safety, gas destruction, generation and grid connection to ensure a high proportion of the coal mine methane that would normally be released to atmosphere is combusted. Investment in generation plant will be phased, totalling 5.1MW in year 1, 10.2MW in year 2 and nearly 12.0MW from year 3 onwards. This is an indicative schedule only and will depend on progress with mine development, methane drainage and coal production, and also on the unit size of generator selected.

The project will contribute to sustainable development in a number of ways:

Environmental: by significantly improving local air quality and addressing greenhouse gas emissions. The project will not lead to the consumption of significant natural resources.



The project will not result in a material increase in energy consumption because the pumping station has already been installed in order to comply with safety requirements; therefore any electricity used by the pumping station is included in the baseline. Generator noise will be mitigated by sound-proofing the containers in which they are placed. Emissions from the generators will not exceed environmental requirements. The waste heat from the generators will remove the need to consume coal to heat the mine intake air, further saving natural resources and contributing to local air quality.

The project will provide social benefits by significantly improving health and safety for workers and economic benefits by providing a new source of clean electricity displacing coal-fired power. The waste heat from the generators will also be used to heat the mine intake ventilation air and thereby improve working conditions within the mine and reduce the consumption of coal.

Technology transfer benefits will arise from the installation of state-of-the-art generation and heat recovery equipment and associated safety and monitoring equipment and systems.

### **A.3. Project participants:**

| Name of Party Involved (*)<br>((host) indicates a host Party) | Private and/or public entity(ies) project participants (as applicable) | Indicate if the Party involved wishes to be considered as project participant (Yes/No) |
|---|--|--|
| People's Republic of China<br>(host)                          | Shanxi Coking Coal Group Company Ltd                                   | No   |
| United Kingdom of Great Britain and Northern Ireland          | Sindicatum Carbon Capital Ltd  | No   |

(\*) In accordance with the CDM modalities and procedures, at the time of making the CDM-PDD public at the stage of validation, a Party involved may or may not have provided its approval. At the time of requesting registration, the approval by the Party(ies) involved is required.

### **A.4. Technical description of the project activity:**

#### **A.4.1. Location of the project activity:**

##### **A.4.1.1. Host Party(ies):**

China



**A.4.1.2. Region/State/Province etc.:**

Shanxi Province

**A.4.1.3. City/Town/Community etc:**

Duerping Coal Mine, Wanbailim District, Taiyuan, Shanxi Province, 030022

**A.4.1.4. Detail of physical location, including information allowing the unique identification of this project activity (maximum one page):**

The coal mine is located 20 km West of Taiyuan, the capital of Shanxi Province. The generation site is 8km South West of the mine. The coal mine reserves are located within the area defined by the following coordinates:

Latitude: North 112° 14' 27”

Longitude: East 37° 46' 52”



**A.4.2. Category(ies) of project activity:**

Sectoral Category 8 – Mining and mineral production

Sectoral category 10 – Fugitive emissions from fuels

Sectoral Category 1 - Energy industries (renewable - / non-renewable sources)

**A.4.3. Technology to be employed by the project activity:**

State-of-the-art methane combustion and power generation systems will be installed on site. These will involve:

- Pipe-work, valves and flame arrestors connecting the gas extraction station, where methane is currently being vented to atmosphere, to the generators
- Condensate extraction systems
- Monitoring equipment to measure the flow, pressure and temperature and concentration of gases as they are extracted from the mine
- State-of-the-art methane fuelled gas-engines and electricity generating sets
- Grid connections to enable export of electricity to the regional grid
- Power connections to enable use of electricity on site
- Heat exchange units to recover heat from the exhaust and/or engine casings from the generators and transfer this to the mine ventilation intake air
- Monitoring procedures to collect and store the data necessary to demonstrate the combustion of methane in a transparent and accurate manner.

**A.4.4 Estimated amount of emission reductions over the chosen crediting period:**

The project is expected to reduce GHG emissions as shown in the table below:

| <b>Years</b>  | <b>Annual estimation of emission reductions in tonnes of CO<sub>2</sub> e</b> |
|---|---|
| Oct-Dec 08  | 41,325  |
| 2009  | 325,395   |
| 2010  | 378,748   |
| 2011  | 378,748   |
| 2012  | 378,748   |
| 2013  | 378,748   |
| 2014  | 378,748   |
| 2015  | 378,748   |
| 2016  | 378,748   |
| 2017  | 378,748   |
| Jan-Sep 2018  | 284,061   |
| <b>Total estimated reductions (tonnes of CO<sub>2</sub>e)</b>                                       | <b>3,680,764</b>  |
| <b>Total number of crediting years</b>  | <b>10</b>   |
| <b>Annual average over the crediting period of estimated reductions (tonnes of CO<sub>2</sub>e)</b> | <b>368,076</b>  |



**A.4.5. Public funding of the project activity:**

The project activity will not be funded by any public money.

**SECTION B. Application of a baseline and monitoring methodology****B.1. Title and reference of the approved baseline and monitoring methodology applied to the project activity:**

- ACM0008 version 03 “Consolidated baseline methodology for coal bed methane and coal mine methane capture and use for power (electrical or motive) and heat and/or destruction by flaring”.
- ACM0002 Version 06 “Consolidated baseline methodology for grid-connected electricity generation from renewable sources”
- “Tool for the demonstration and assessment of additionality” Version 4
- “Tool to determine project emissions from flaring gases containing methane”

Detailed information regarding these methodologies and tools please refer to <http://cdm.unfccc.int/methodologies/approved>.

**B.2 Justification of the choice of the methodology and why it is applicable to the project activity:**

The project activity fulfils the applicability criteria for the use of this methodology:

- The project activity is implemented in a working coal mine
- The mine uses underground boreholes to capture post-mining CMM
- The methane will be captured and destroyed through combustion for electricity generation and flaring.

The project activity does not operate in an open cast mine; involve any decommissioned mines; use virgin coal-bed methane or use CO<sub>2</sub> or any other gas to enhance methane recovery.

The use of this methodology requires access to data to enable ex ante projections of methane demand. As there is no methane demand in the baseline scenario, there is no requirement for such information.

No CBM will be involved – there are no CBM wells in the vicinity of the project, no CBM pipelines and no plans or approval for surface CBM drilling at the mine. This is due to the combination of depth, low permeability of coal seams, difficult terrain and adequate gas drainage capacity underground which makes consideration of surface pre-drainage using CBM unnecessary and in any event too costly. All the CMM to be used by the project is drained underground and transmitted by a pipeline which comes to the surface at the upcast ventilation shaft adjoining the CMM utilisation site.

**B.3. Description of the sources and gases included in the project boundary****Baseline**

| Source  | Gas              |          | Justification / Explanation                                    |
|---|------------------|----------|--|
| Emissions of methane as a result of venting           | CH <sub>4</sub>  | Included | • Main emission source.  |
| Emissions from destruction of methane in the baseline | CO <sub>2</sub>  | Excluded | • There is no methane destruction in the baseline              |
|   | CH <sub>4</sub>  | Excluded |  |
|   | N <sub>2</sub> O | Excluded |  |
| Grid electricity                                      | CO <sub>2</sub>  | Included | • Only CO <sub>2</sub> emissions associated with the net power |



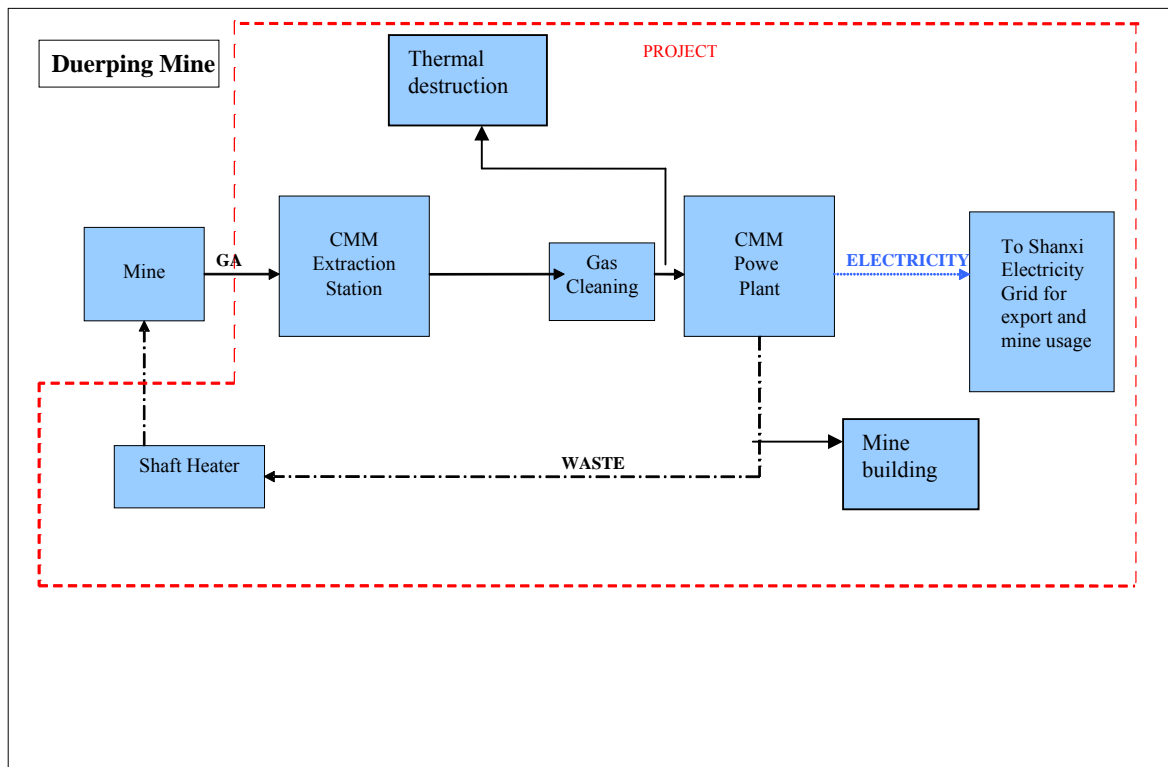


|   |                  |          |  |
|---|------------------|----------|--|
| generation<br>(electricity provided<br>to the grid)   |                  |          | generated by the project activity are included.<br>• Use of combined margin method as described in ACM0002 should be used. |
|   | CH <sub>4</sub>  | Excluded | • Excluded for simplification. This is conservative.   |
|   | N <sub>2</sub> O | Excluded | • Excluded for simplification. This is conservative.   |
| Captive power<br>and/or heat, and<br>vehicle fuel use | CO <sub>2</sub>  | Included | • Baseline scenario includes coal combustion for heating mine in-take air in the winter months.                            |
|   | CH <sub>4</sub>  | Excluded | • Excluded for simplification. This is conservative.   |
|   | N <sub>2</sub> O | Excluded | • Excluded for simplification. This is conservative.   |

**Project activity**

| Source  | Gas              |          | Justification / Explanation  |
|---|------------------|----------|--|
| Emissions of methane as a result of continued venting                                 | CH <sub>4</sub>  | Excluded | • Only the change in CMM emissions release will be taken into account, by monitoring the methane used or destroyed by the project activity.  |
| On-site fuel consumption due to the project activity, including transport of the gas  | CO <sub>2</sub>  | Included | • However, the project does not use any additional energy as the pumping station is part of the baseline scenario.   |
|   | CH <sub>4</sub>  | Excluded | • Excluded for simplification. This emission source is assumed to be very small.   |
|   | N <sub>2</sub> O | Excluded | • Excluded for simplification. This emission source is assumed to be very small.   |
| Emissions from methane destruction  | CO <sub>2</sub>  | Included | • From the combustion of methane in power generation and flaring.  |
| Emissions from NMHC destruction   | CO <sub>2</sub>  | Included | • From the combustion of NMHC, if it accounts for more than 1% by volume of extracted coal mine gas.<br>• NMHC are less than 1%, therefore in practice these emissions are excluded – to be confirmed annually |
| Fugitive emissions of unburned methane  | CH <sub>4</sub>  | Included | • Small amounts of methane will remain unburned in heat/power generation. Default emission factors are applied as per ACM0008.   |
| Fugitive methane emissions from on-site equipment                                     | CH <sub>4</sub>  | Excluded | • Excluded for simplification. This emission source is assumed to be very small.   |
| Fugitive methane emissions from gas supply pipeline or in relation to use in vehicles | CH <sub>4</sub>  | Excluded | • Excluded for simplification. However taken into account among other potential leakage effects (see leakage section)  |
| Accidental methane release  | CH <sub>4</sub>  | Excluded | • Excluded for simplification. This emission source is assumed to be very small.   |

Figure 1 below shows the project boundary:



**B.4. Description of how the baseline scenario is identified and description of the identified baseline scenario:**

The proof that the project activity is not part of the business as usual scenario is given by firstly identifying the baseline scenario following a series of steps described in the methodology, followed by the application of steps 2 (or 3) to 5 of the additionality tool.

**ACM0008 Step 1: Identify technically feasible options for capturing and/or using CBM or CMM**

Step 1a: Options for CBM and CMM extraction

| Option for capture      | Comment  |
|-------------------------|--|
| Ventilation air methane | Removal of coal mine methane through ventilation alone in gassy mines is not practical. Ventilation systems cannot cope with sudden emissions of gas or with increases in gas concentration arising from mining of coal or changes in barometric pressure. Sufficiently high volumes of air to dilute the methane would create dust and particle movement within the mine, consume excessive energy and would not improve the safety of the mine |
| Pre-mining CMM and CBM  | Pre mining CMM extraction is not effective due to the low permeability of the worked seam and at Duerping mine reliance is placed on post mining CMM extraction to control gas emissions.<br>Coal bed methane drainage from the surface is not applied in this mine  |



(nor is it widely applied in China to date). It is not considered practical in this mine because of the low permeability of the coal seams.

Post mining CMM extraction This is practiced and involves drilling holes above and below the coal seam from an underground location. Pipes are inserted into the holes, sealed around the sleeve and then suction pressure applied to withdraw methane. Current legislative programmes, and in particular the pressure upon mine owners to improve safety in Chinese coal mines, means that over time, the efficacy of coal mine methane drainage can be expected to improve.

Conclusion: Duerping Coal Mine relies principally on two types of methane extraction: ventilation air and post mining CMM. The project activity does not impact upon these practices.

#### Step 1b: Options for extracted CBM and CMM treatment

| Options                                      | Comment  |
|--|--|
| Venting                                      | This is the current practice and is most likely to continue in the baseline scenario. There are no barriers to this activity.  |
| Use / destruction of ventilation air methane | There is no requirement, nor incentive, to treat VAM. Technologies for its destruction and use are experimental and costly.  |
| Flaring of CBM/CMM                           | Flaring of CMM is not a likely scenario in the baseline because there is no requirement to do so and there is no reason why mine owners should invest in the equipment where there are no benefits to them.  |
| Use for additional grid power generation     | Power generation from CMM is part of the project activity. Although the CMM contains combustible quantities of methane, there is no requirement to treat the methane. Electricity production is not the mine's primary function; investment in efficient, modern CMM utilization equipment is not common in the region, nor in China, and appropriate scale and efficient generators that can reliably operate with the variable qualities of methane experienced are not locally available. The tariffs paid for power generation are very low (0.26 RMB or approximately 3 US cents per kWh) which does not make it a financially attractive option. These factors present a range of barriers, obstacles and risks to the mine operators. |
| Use for captive power / heat generation      | Displacement of captive heat is part of the project activity. Without the power generation component, there would be no excess heat to utilise and therefore this option would not be available. Combustion of the methane for heat alone would not be attractive because of the plentiful and cheap supplies of coal that are available, coal fired boilers have very recently been constructed and are operating without problems.   |
| Use for additional heat requirements         | There is no existing heating infrastructure and no interest in investing in such infrastructure. The point where the CMM is released is remote to any settlements, making piping to a community unattractive. Investment in such a system is further discouraged because of the low price of coal adjacent to coal mines. Householders are not willing to pay for gas when they can have coal very cheaply<br>( <a href="http://www.coalinfo.net.cn/coalbed/meeting/2203/papers/coal-mining/001.pdf">http://www.coalinfo.net.cn/coalbed/meeting/2203/papers/coal-mining/001.pdf</a> )  |
| Feed into gas pipeline                       | There is no gas pipeline available   |
| Combinations of the above                    | No combination of the above activities is likely because any division of   |



the CMM between different uses would present multiple barriers and detract from the economic rationale.

Conclusion: Venting is the most likely baseline scenario.

#### Step 1c: Options for energy generation

| Options   | Comment   |
|---|---|
| No generation                                       | This is the current practice and is most likely to continue in the baseline scenario. There are no barriers to this activity.   |
| Use of methane for heating purposes                 | There is no existing heating infrastructure and no interest in investing in such infrastructure. Investment in such a system is further discouraged because of the low price of coal adjacent to coal mines. Householders are not willing to pay for gas when they can have coal very cheaply ( <a href="http://www.coalinfo.net.cn/coalbed/meeting/2203/papers/coal-mining/001.pdf">http://www.coalinfo.net.cn/coalbed/meeting/2203/papers/coal-mining/001.pdf</a> ). The point of release is remote to any community.   |
| Use of methane for power generation for use on site | Power generation from CMM for use on site is part of the project activity. Although the CMM contains combustible quantities of methane, there is no requirement to treat the methane. Electricity production is not the mine's primary function; investment in utilization equipment is not common in the region, nor in China and they already source their power from the grid where the supply is reliable. National regulations do not permit the use of the power on site in theory. In practice, the power may be used, but it must be sold to the grid at a low rate (26 Chinese cents or approximately 3 US cents and bought back at 6 US cents per kWh). These factors present a range of barriers, obstacles and risks to the mine operators. |
| Use of methane for power generation for export      | Power generation from CMM for export is part of the project activity. Although the CMM contains combustible quantities of methane, there is no requirement to treat the methane. Electricity production is not the mine's primary function; investment in utilization equipment is not common in the region, nor in China. Generated power must be sold to the grid and the tariff paid is low – 26 Chinese cents per kWh. Or approximately 3 US cents. These factors present a range of barriers, obstacles and risks to the mine operators.   |
| Use of methane for transport                        | There is no experience in the use of CMM for transport in the region, only high purity CBM (as CNG) would normally be considered for transport use and the CMM would therefore need treatment to raise the methane purity which would be very costly. Too many barriers exist to consider this means of utilizing the methane.  |

Conclusion: The baseline scenario is no power generation.

#### **ACM0008 Step 2: Eliminate baseline scenarios that do not comply with legal or regulatory requirements**

##### CMM extraction

Continuation of current practice of pre- and post-mining CMM and ventilation of the mine is a possible baseline scenario, however, in view of increased pressure to improve safety performance in mines in the



form of criminal prosecutions for mine owners and incentive programmes and tax benefits, it is more likely that there will be some improvement in the current practice. See for example: [http://www.chinadaily.com.cn/english/doc/2004-12/02/content\\_396698.htm](http://www.chinadaily.com.cn/english/doc/2004-12/02/content_396698.htm) (website last visited on the 30.08.06) and go to <http://www.china-labour.org.hk/public/main> and search on coal mine explosions to see a long list reports on casualties and government efforts to improve coal mine safety, including through better methane drainage.

This report quoting the China Daily news from January 2004 <http://www.epa.gov/cmop/resources/notes/2004/1-22.html> (website last visited on the 30.08.06) reports a 10% increase in the budget for safety in Chinese coal mines, including increased emphasis on coal mine methane extraction and announces tax incentives for projects that drain and utilize methane.

See also <http://www.china.org.cn/english/2004/Nov/112962.htm> (website last visited on the 30.08.06) which although it pre-dates the above government initiatives, shows that the authorities are prepared to enforce the initiatives.

In view of the above information, it is argued that continuation of current practice in methane drainage and ventilation is unlikely and that a gradual improvement over time, even to a small degree, in the efficiency of methane drainage and ventilation is the more likely baseline scenario.

#### CMM treatment

There are no legal or regulatory requirements concerning the treatment of coal mine methane. As stated in A.4.4. above, the primary legislation makes no reference to coal mine methane emissions; likewise, the 1996 Decision of the State Council on Several Issues Concerning Environmental Protection makes no reference to coal mine methane (go to <http://www.chinalaw.gov.cn/indexEN.jsp> (website last visited on the 30.08.06) and search laws and regulations for “environmental protection”). All of the legal and regulatory requirements focus on the safety aspects of coal mining, which generally involve extracting methane from the mine. There are no requirements concerning the use or treatment of the methane. Therefore all of the above baselines are possible from a legal and regulatory point of view.

The government is working to reduce the unacceptably high incidence of coal mine related accidents and deaths, and those responsible for mines are now being charged with a range of offences – see for example <http://www.china.org.cn/english/2004/Nov/112962.htm> (website last visited on the 30.08.06).

#### **ACM0008 Step 3: Formulate baseline scenario alternatives**

Possible baselines for the extraction of CMM are:

- 1) Improve and extend the current practice of pre- and post-CMM and ventilation of the mine
- 2) Implement coal bed methane drainage

Possible baselines for the treatment of extracted CMM are:

- a) Continued release to atmosphere
- b) Flaring of CMM
- c) Utilisation of CMM for electricity (captive or grid), heat, or motive power

All combinations of the above scenarios are possible baseline scenarios.

#### **ACM0008 Step 4: Eliminate baseline scenario alternatives that face prohibitive barriers**



#### CMM and CBM extraction

Surface CBM extraction from conventional, vertical, hydrofractured wells is not an option due to the low permeability of the coal seams at Duerping, and the high cost and unproven nature of the latest surface to in seam drilling technologies which can, in some instances, perform better than vertical wells. This is not a viable option.

In view of this evidence, it is clear that the most likely baseline for extraction is continuation of current practice with potential increases in efficiency and effectiveness of extraction over time due to increased output from the mine and government incentives and legislative requirements. Increases in extraction will result in improved safety conditions and also facilitate increased coal production as part of the business as usual scenario and not a result of the CDM project activity.

#### CMM and CBM treatment

There is no surface CBM production in this project, so it is not discussed further in this section.

The options for CMM treatment are described in Step 1b above. There are no legislative requirements to treat methane and although there is government level interest in using coal bed and coal mine methane for power generation, there are a number of barriers to anything other than continued release to atmosphere. These barriers tend to be anecdotal and therefore the following options for CMM treatment remain:

- a) Continued release to atmosphere
- b) Flaring of CMM
- c) Utilization of CMM for electricity (captive or grid), heat, or motive power

Use/destruction of VAM. VAM can only be destroyed with additional energy inputs or by feeding it into a thermal power station. There is no thermal power station close enough to justify the costs of building ducting and the energy required to pump the VAM to the power station. There are no existing plans to utilize the VAM in the power station.

Combinations of the above options do not help because all they do is reduce the capacity for power generation and associated methane destruction.

### **ACM0008 Step 5 Identify the most economically attractive baseline scenario alternative (optional)**

There are three possible options for the treatment of CMM:

- a) Continued release to atmosphere with purchase of coal for the boilers
- b) Flaring of CMM with purchase of coal for the boilers
- c) Utilization of CMM for electricity (captive or grid) and waste heat supply to the boilers

#### ***Sub-step 5a. – Option I. Apply simple cost analysis***

This option cannot be applied because option c has associated cash flows.

#### ***Sub-step 5b. – Option II. Apply investment comparison analysis***

The indicator to be used for financial analysis of the project activity is selected to be the Net Present value (NPV) in accordance with the “Tool for the demonstration and assessment of additionality”



(version 04). The interest rate applied is the recommended rate of return for Construction Projects in the coal and gas sector, jointly published by the Chinese National Development and Reform Commission and Ministry of Construction in “Economic Evaluation Codes and Parameters for Construction Projects” (Version 03)<sup>1</sup>. The recommended rate is 12% before tax. This value is considered appropriate because it is a benchmark for the decision to invest in construction projects in the coal mining sector, against which this project must compete for finance.

**Table B4-1. Data used for the IRR for option a, incremental costs of release of CMM to atmosphere**

|  |                       |
|--|-----------------------|
| Description: Continuation of current practice – release of CMM to atmosphere |                       |
| Coal purchase 2200 tonnes per annum at RMB 150 per tonne*                    | RMB<br>225,000        |
| NPV at 12%   | - RMB 2.49<br>million |

\* Price for unwashed coal at the pithead

**Table B4-2. Data used for the IRR for option b, incremental costs of flaring of CMM**

|  |                      |
|--|----------------------|
| Description: Coal purchase and flaring of CMM            |                      |
| Coal purchase 2200 tonnes per annum at RMB 150 per tonne | RMB<br>225,000       |
| Capital  | RMB 1.1<br>million   |
| Annual running costs                                     | RMB<br>50,000        |
| NPV @ 12%  | -RMB 3.86<br>million |

**Table B4-3. Data used for the IRR calculation from FSR – incremental costs for option c, utilization of CMM for power generation**

The data used in this NPV calculation are drawn from the IRR calculation presented in the approved Feasibility Study Report.

|  |       |
|--|-------|
| Description: Utilization of CMM for power generation |       |
| Power tariff (Yuan/kWh)*                             | 0.364 |
| Price for power standard gas ( Yuan/m3)              | 0.00  |
| City maintenance tax rate %                          | 7%    |

<sup>1</sup> Source: NDRC and National Construction Committee , 2006 , *Economic Evaluation Code and Parameter for Construction Projects (Version 03 )*P204



|  |                     |
|--|---------------------|
| Education tax rate %   | 3%                  |
| Public welfare fund rate(of the profit after income tax) %                           | 5%                  |
| CMM consumption of Deutz engine (m3/h)   | 1172                |
| Annual operating hours (h)   | 7000                |
| Auxiliary power consumption rate of the project activity %                           | 2.3%                |
| Static total investment (10,000 RMB)   | 14771**             |
| Water cost (Yuan/MWh)  | 5.35                |
| Material cost (Yuan/MWh)   | 3.00                |
| Other cost (Yuan/MWh)  | 5.00                |
| Maintenance cost % of static total investment  | 1.5%                |
| Depreciation period(year)  | 15                  |
| Remained value of the static total investment  | 5%                  |
| Insurance rate(of the remained static total investment)                              | 1.0%                |
| Welfare costs  | 56%                 |
| Salary costs   | 3                   |
| Number of people   | 12                  |
| Capital cost of exhaust heat ducting   | RMB 2 million       |
| Refurbishment costs on generator sets after 64000 hours (7 years operation)***       | 40% of capital cost |
| RMB : EURO exchange rate in 2007 (1 Euro = 8.75866 RMB)                              | 8.75866             |
| 20 year average projected annual inflation rate China (source Global Insight)        | 3.3%                |
| 20 year average project annual inflation rate Western Europe (source Global Insight) | 1.8%                |
| NPV at 12%   | -RMB 22.07 million  |
| coal cost RMB per tonne, unwashed at the pithead                                     | 150                 |
| annual consumption (tonnes)  | 2200                |

\* There is no power purchase agreement at present because the electricity will be consumed by the mine's own operations, displacing power drawn from the grid. The tariff used here is the tariff at which the mine purchases electricity from the grid.

\*\*The FSR quotes a value of 103,040,000 RMB for the static total investment however, a higher value has been applied in the NPV calculation. This is because the FSR only estimated the costs of the generating equipment which were subsequently found to be significantly higher. Documentation (in the form of the EPC contract for the purchase of the generators and actual receipts) confirms that this price was known before the start date of the project.

This cost has been further increased by RMB 2 million to account for the cost of the installation of insulated piping and heat exchangers for the transfer of waste heat from the generators to the ventilation





intake. This cost was identified prior to the start of the project but was not included in the FSR calculations.

The total static investment is determined, based on receipts, as follows:

| Receipt description                             | Cost for 3 engines (*10,000 RMB) | Cost for 1 engine (column 2/3) (*10,000 RMB) | Comment  |
|---|----------------------------------|--|--|
| 3 Gensets                                       | 4436.34                          | 1478.78                                      | As shown on receipt  |
| 3 control units                                 | 73.31                            | 24.44  | As shown on receipt  |
| 1.5 waste heat units                            | 90.00                            | 60.00  | Cost for 3 engines is 2 times the face value of the receipt  |
| 0.75 gas purification units                     | 108.00                           | 48.00  | Cost for three engines 4/3 times the value   |
| Sub-total                                       |                                  | 1611.22                                      | Proportional cost of one genset and control systems  |
| Sub total for 7 flares                          |                                  | 11278.51                                     | Purchased over 2 years   |
| Sub total with non power gen equipment included |                                  | 14240.54                                     | The percentage of power generation related equipment in the static total investment (79%) – from FSR |
| One flare unit                                  |                                  | 330  | As shown on receipt  |
| Ducting for heat transfer                       |                                  | 200  | Estimate (less than 1.5% of total costs)   |
| Total Static Investment                         |                                  | 14770.54                                     |  |

\*\*\* The FSR does not include any costs for the refurbishment of the generators. The engines require an overhaul after 64,000 hours of operation = once per 7 years. The estimated cost of the overhaul is 40% of the capital cost and the Euro costs have been adjusted to take account of the differences in the long term average inflation rates in Western Europe and China as follows:

|         |      |      |      |      |      |      |      |       |       |       |       |       |       |       |       |       |    |
|---------|------|------|------|------|------|------|------|-------|-------|-------|-------|-------|-------|-------|-------|-------|----|
| Year:   | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015  | 2016  | 2017  | 2018  | 2019  | 2020  | 2021  | 2022  | 2023  | 20 |
| RMB:EUR | 9.06 | 9.28 | 9.44 | 9.60 | 9.71 | 9.84 | 9.96 | 10.08 | 10.20 | 10.33 | 10.44 | 10.56 | 10.69 | 10.82 | 10.95 | 11.09 | 11 |

**Table B.4-4. Comparison of the project NPV for different potential baseline scenarios**

|   | NPV after tax (RMB) |
|---|---------------------|
| Continuation of current practice – release of methane to atmosphere and purchase of coal for heating mine shaft air | -RMB 2.49 million   |
| Coal purchase and flaring of CMM  | -RMB 3.86 million   |



|                           |                     |
|---------------------------|---------------------|
| Power generation with CMM | - RMB 22.07 million |
|---------------------------|---------------------|

This analysis clearly shows that the most attractive (least unattractive) course of action is scenario a), continuation of current practice. Both of the other alternatives have negative NPVs.

**Sub-step 5c. Sensitivity analysis:**

A sensitivity analysis has been performed on the above scenarios;

**Table B4-5: Sensitivity analysis NPV (RMB 10,000)**

| Scenario                | 90.00%    | 95.00%    | 100%      | 105.00%   | 110.00%   |
|-------------------------|-----------|-----------|-----------|-----------|-----------|
| Coal only               | -224.59   | -237.07   | -249.55   | -262.02   | -274.50   |
| Coal and flare          |           |           |           |           |           |
| Capital costs           | -375.75   | -380.66   | -385.57   | -390.48   | -395.39   |
| Running costs           | -381.79   | -383.68   | -385.57   | -387.46   | -389.35   |
| Power generation        |           |           |           |           |           |
| Static total investment | -438.04   | -1,319.79 | -2,207.42 | -3,100.92 | -4,000.29 |
| Annual operating cost   | -1,918.89 | -2,063.05 | -2,207.42 | -2,351.99 | -2,496.76 |
| Power tariff            | -3,890.30 | -3,048.86 | -2,207.42 | -1,365.98 | -524.54   |

The most favorable option is the continuation of current practice, which is the purchase of coal and venting of untreated methane. The least favorable option is the generation of electricity from the CMM, which is the proposed project activity.

The data in the table clearly shows that this ranking of the options for highest returns (lowest losses) remains unchanged throughout the sensitivity analysis.

At this stage it is now clear that there is only one likely baseline scenario:

Improvement in the efficiency and extension of methane extraction from the mine combined with continued release of untreated methane to atmosphere and purchase of coal to run ventilation air heating boilers.

This scenario is entirely consistent with what is currently happening at the mine. During an initial visit to ascertain the potential for CDM, coal mine methane drainage and VAM release to atmosphere was observed. The CMM was being drained by three liquid ring gas extraction pumps. This gas extraction station is being replaced by a new installation at a remote surface location situated closer to the current area of mining activity. The plinths for five gas extraction pumps and motors have been cast and three pumps, gearboxes and motors installed. It is planned to add the two remaining pumps at a future stage. The 2BEC72 single lobe water ring seal gas extraction pumps are manufactured by Zibo Ltd, China. The motors are 6 kV, 560 kW 990 rpm. The gearbox is designed to turn the pump at 275 rpm. A recirculation



valve will be included in the system to facilitate regulation of suction. The capacity of the pumps exceeds the current mine requirements but is expected to be utilized as the mine production increases.

**B.5. Description of how the anthropogenic emissions of GHG by sources are reduced below those that would have occurred in the absence of the registered CDM project activity (assessment and demonstration of additionality):**

The proposed project activity will not occur without CDM assistance. “Tools for the demonstration and assessment of additionality” (version 04) will be used to test the additionality of the proposed project.

On 1<sup>st</sup> December 2004, as a major annual event in the coal mining industry in China, the 4<sup>th</sup> International Symposium on CBM/CMM was held in Beijing China. In the symposium, CDM was a major topic to encourage coalmines to utilize CMM. After the symposium, the concept of CDM was spread around major Shanxi mining groups, where the project owner alongside numerous other mines started to consider implementing its CMM utilization project with the assistance from CDM.

On 19<sup>th</sup> January 2005, a CDM meeting was organized by the Shanxi Development and Reform Committee to introduce CDM more actively to the Project Owner. A representative of Sindicatum Ltd attended this meeting and on 20<sup>th</sup> January 2005, Shanxi Coking Coal Group Co Ltd discussed CDM cooperation in Sindicatum Ltd’s Representative office in Beijing.

Sindicatum Carbon Capital was incorporated in March 2005 and one of the Shanxi Coking Coal was one of the projects listed at this early stage. From this time, negotiations continued with Shanxi Coking Coal Group Company Ltd over the development of CDM projects at a number of their mines. Duerping was selected as the first mine to be developed. The first version of the PDD was prepared on 24<sup>th</sup> August 2006. Proposals for validation of the project were received from TUV Sud (dated 1<sup>st</sup> October 2006) and DNV (dated 10<sup>th</sup> October 2006). TUV Sud were appointed to undertake the validation and a contract was signed accordingly. The local stakeholder consultation was performed on 30<sup>th</sup> October 2006 and the international stakeholder consultation commenced on 28<sup>th</sup> November 2006.

As stated in section C below, the starting date of the project activity, when SCC committed to the purchase of generating equipment, was 19<sup>th</sup> March 2007. All efforts and expenditure up to that point were of a preparatory nature, required to create the necessary legal structure for the implementation of the project.

Prior to the start date of the project activity, both:

- a) Documentation relating to the CDM had been in the public domain for several months; and
- b) A contract had been signed with, and a down payment made to, TUV Sud.

These facts provide ample evidence that CDM was seriously considered prior to the start date of the project activity.

Assessment and demonstration of additionality

ACM0008 ver 3 states that “because of the similarity of both approaches used to determine the baseline scenario and the additionality tool, step 1 of the tool for the demonstration and assessment of additionality can be ignored.”

**Additionality Tool Step 2: Investment Analysis**

**Step 2a: Determine appropriate analysis method**

The “Tools for the demonstration and assessment of additionality” (version 04) recommends three analysis methods, including simple cost analysis (Option I), investment comparison analysis (Option II) and benchmark analysis (Option III). ACM0008 Ver 3 states that if the investment analysis approach is used, project participants “should identify whether the baseline scenario selected above is economically and/or financially more attractive than the CDM project activity if not registered as a CDM project.”

The baseline scenario selected above is improvement in the efficiency and extension of methane extraction from the mine combined with continued release of untreated methane to atmosphere and purchase of coal to run ventilation air heating boilers. The project activity without CDM is the generation of electricity from the CMM and the use of waste heat to heat ventilation intake air. Improvement in the efficiency and extension of methane extraction from the mine is common to both the project activity and the baseline scenario so the following investment analysis compares the financial attractiveness of continued release of methane to the atmosphere and coal purchase with power generation from the methane and utilization of waste heat.

**Step 2b: Option II: Investment Comparison Analysis (Option II)**

The indicator to be used for financial analysis of the project activity is selected to be the Net Present Value (NPV) in accordance with the “Tool for the demonstration and assessment of additionality” (version 04). The interest rate applied is the recommended rate of return for Construction Projects in the coal and gas sector, jointly published by the Chinese National Development and Reform Commission and Ministry of Construction in “Economic Evaluation Codes and Parameters for Construction Projects” (Version 03)<sup>2</sup>. The recommended rate is 12% before tax. This value is considered appropriate because it is a benchmark for the decision to invest in construction projects in the coal mining sector, against which this project must compete for finance.

**Sub-step 2c. Calculation and comparison of financial indicators****Table B5-1. Data used for the IRR for option a, incremental costs of release of CMM to atmosphere**

|  |                       |
|--|-----------------------|
| Description: Continuation of current practice – release of CMM to atmosphere and purchase of coal for mine shaft heaters |                       |
| Coal purchase 2200 tonnes per annum at RMB 150 per tonne   | RMB<br>225,000        |
| NPV at 12%   | - RMB 2.49<br>million |

<sup>2</sup> Source: NDRC and National Construction Committee , 2006 , Economic Evaluation Code and Parameter for Construction Projects (Version 03 )P204

**Table B5-2. Data used for the IRR calculation from FSR – incremental costs for option c, utilization of CMM for power generation**

The data used in this NPV calculation are drawn from the IRR calculation presented in the approved Feasibility Study Report.

| Description: Utilization of CMM for power generation                           |                     |
|--|---------------------|
| Power tariff (Yuan/kWh)*   | 0.364               |
| Price for power standard gas ( Yuan/m3)  | 0.00                |
| City maintenance tax rate %  | 7%                  |
| Education tax rate %   | 3%                  |
| Public welfare fund rate(of the profit after income tax) %                     | 5%                  |
| CMM consumption of Deutz engine (m3/h)   | 1172                |
| Annual operating hours (h)   | 7000                |
| Auxiliary power consumption rate of the project activity %                     | 2.3%                |
| Static total investment (10,000 RMB)   | 14771**             |
| Water cost (Yuan/MWh)  | 5.35                |
| Material cost (Yuan/MWh)   | 3.00                |
| Other cost (Yuan/MWh)  | 5.00                |
| Maintenance cost % of static total investment                                  | 1.5%                |
| Depreciation period(year)  | 15                  |
| Remained value of the static total investment                                  | 5%                  |
| Insurance rate(of the remained static total investment)                        | 1.0%                |
| Welfare costs  | 56%                 |
| Salary costs   | 3                   |
| Number of people   | 12                  |
| Capital cost of exhaust heat ducting   | RMB 2 million       |
| Refurbishment costs on generator sets after 64000 hours (7 years operation)*** | 40% of capital cost |
| NPV at 12%   | -RMB 22.07 million  |
| coal cost RMB per tonne, unwashed at the pithead                               | 150                 |
| annual consumption (tonnes)  | 2200                |

\* There is no power purchase agreement at present because the electricity will be consumed by the mine's own operations, displacing power drawn from the grid. The tariff used here is the tariff at which the mine purchases electricity from the grid.

\*\*The FSR quotes a value of 103,040,000 RMB for the static total investment however, a high value has been applied in the NPV calculation. This is because the FSR only estimated the costs of the generating



equipment which were subsequently found to be significantly higher. Documentation (in the form of the EPC contract for the purchase of the generators and actual receipts) confirms that this price was known before the ERPA the start date of the project.

This cost has been further increased by RMB 2 million to account for the cost of the installation of insulated piping and heat exchangers for the transfer of waste heat from the generators to the ventilation intake. This cost was identified prior to the start of the project but was not included in the FSR calculations. The total static investment is determined, based on receipts, as follows:

| Receipt description                             | Cost for 3 engines (*10,000 RMB) | Cost for 1 engine (column 2/3) (*10,000 RMB) | Comment  |
|---|----------------------------------|--|--|
| 3 Gensets                                       | 4436.34                          | 1478.78                                      | As shown on receipt  |
| 3 control units                                 | 73.31                            | 24.44  | As shown on receipt  |
| 1.5 waste heat units                            | 90.00                            | 60.00  | Cost for 3 engines is 2 times the face value of the receipt  |
| 0.75 gas purification units                     | 108.00                           | 48.00  | Cost for three engines 4/3 times the value   |
| Sub-total                                       |                                  | 1611.22                                      | Proportional cost of one genset and control systems  |
| Sub total for 7 flares                          |                                  | 11278.51                                     | Purchased over 2 years   |
| Sub total with non power gen equipment included |                                  | 14240.54                                     | The percentage of power generation related equipment in the static total investment (79%) – from FSR |
| One flare unit                                  |                                  | 330  | As shown on receipt  |
| Ducting for heat transfer                       |                                  | 200  | Estimate (less than 1.5% of total costs)   |
| Total Static Investment                         |                                  | 14770.54                                     |  |

\*\*\* The FSR does not include any costs for the refurbishment of the generators. The engines require an overhaul after 64,000 hours of operation = once per 7 years. The estimated cost of the overhaul is 40% of the capital cost and the Euro costs have been adjusted to take account of the differences in the long term average inflation rates in Western Europe and China as follows:

|         |      |      |      |      |      |      |      |       |       |       |       |       |       |       |       |    |
|---------|------|------|------|------|------|------|------|-------|-------|-------|-------|-------|-------|-------|-------|----|
| Year:   | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016  | 2017  | 2018  | 2019  | 2020  | 2021  | 2022  | 2023  | 20 |
| RMB:EUR | 9.06 | 9.28 | 9.44 | 9.60 | 9.71 | 9.84 | 9.96 | 10.08 | 10.20 | 10.33 | 10.44 | 10.56 | 10.69 | 10.82 | 10.95 | 11 |



Table B.5-3 shows the calculated NPV for the two potential scenarios:

**Table B.5-3. Comparison of the baseline scenario NPV with the Project activity NPV**

|  | NPV after tax       |
|--|---------------------|
| Continuation of current practice – release | - RMB 2.49 million  |
| Power generation with CMM                  | - RMB 22.07 million |

#### Sub-step 2d: Sensitivity analysis

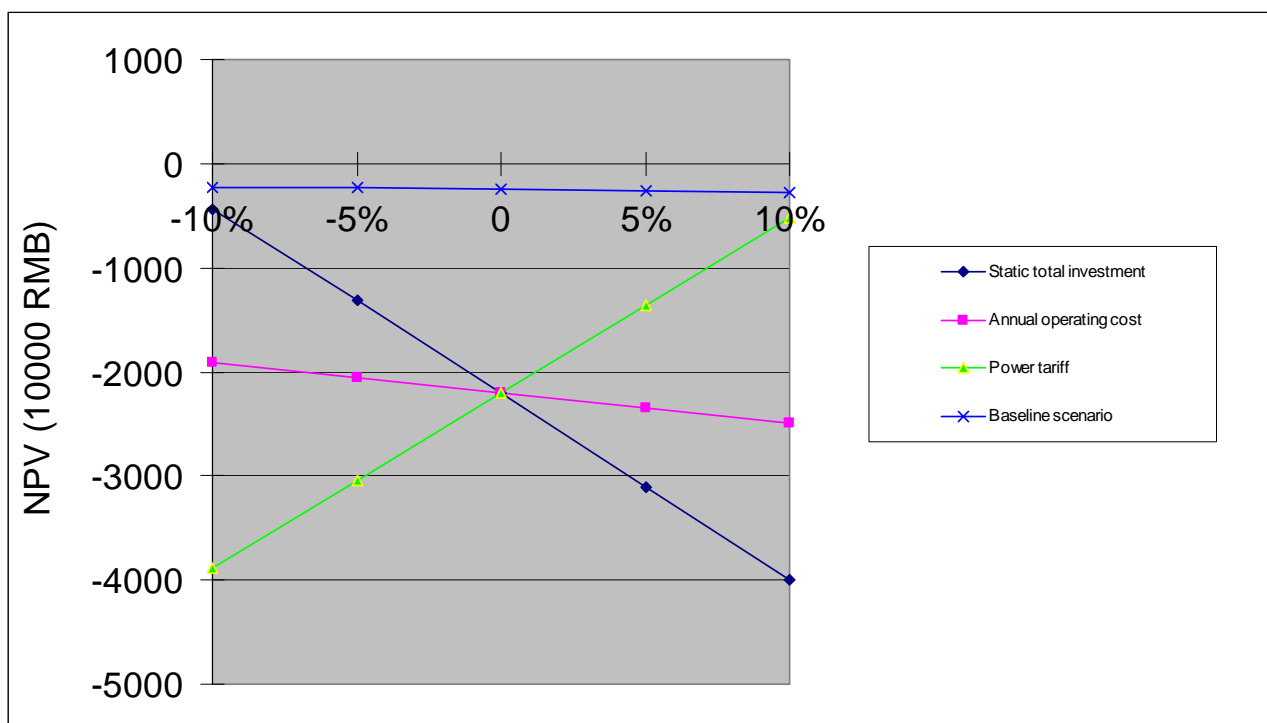
The sensitivity analysis shall show whether the conclusion regarding the financial attractiveness is robust to reasonable variations in the critical assumptions. For such purpose, three parameters were selected as sensitive factors to check out their effects on project NPV.

1. Static total investment
2. Annual operating cost
3. Annual power supply

The NPV will fluctuate with the variations (-10% to 10%) of the above three factors. The result is demonstrated in Table B.5-3 and Figure B.5-1.

**Table B.5-3. NPV before tax Sensitivity analysis (10,000 RMB)**

| Scenario         | Variable                | -10%      | -5%       | 0         | 5%        | 10%       |
|------------------|-------------------------|-----------|-----------|-----------|-----------|-----------|
| Baseline         | Coal price              | -224.59   | -237.07   | -249.55   | -262.02   | -274.50   |
| Project activity | Static total investment | -438.04   | -1,319.79 | -2,207.42 | -3,100.92 | -4,000.29 |
|                  | Annual operating cost   | -1,918.89 | -2,063.05 | -2,207.42 | -2,351.99 | -2,496.76 |
|                  | Annual power supply     | -3,890.30 | -3,048.86 | -2,207.42 | -1,365.98 | -524.54   |



**Figure B.5-1. NPV Sensitivity Analysis**

It could be seen from Table B.5-3 and Figure B.5-1 that the project activity does not compare well against the proposed baseline scenario. Under no circumstances is the project even remotely attractive compared to the proposed baseline scenario.

It is quite clear the proposed project activity would not be undertaken without some additional source of revenue. In SCC's case, that incentive is the CDM. Assuming a CER sales price of USD 10, the NPV increases to approx + RMB 12 million with an IRR of approximately 26%.

#### **Additionality Tool Step 3: Barrier analysis**

Not selected because most of the evidence to support the presence of barriers is anecdotal.

#### **Additionality Tool Step 4: Common Practice Analysis**

##### ***Sub-step 4a. Analyze other activities similar to the proposed project activities***

Although there is interest in using coal mine methane for power generation, references prove that its development is limited in China.





For example: <http://www.coalinfo.net.cn/coalbed/meeting/2203/papers/coal-mining/005.pdf> (website last visited on the 30.08.06) states that: “There are few CMM power generation schemes in China because local authorities and mining enterprises for social reasons often consider domestic consumers a priority. Additionally, achieving an electrical grid connection can be problematic at present. However, there is potential to develop more CMM schemes to supply power to mines as they have a predictable base load and offer a number of advantages as a customer for the generated power.”

These statements are further supported by the PDD for the Pansan Coal Mine utilisation and destruction project:

(<http://cdm.unfccc.int/methodologies/PAMethodologies/publicview.html?cases=A&single=1&OpenNM=NMM0075>). (website last visited on the 30.08.06)

The paper by Prof Huang Shengchu et al of the China Coal Information Institute available at <http://www.coalinfo.net.cn/coalbed/meeting/2203/papers/coal-mining/001.pdf> (website last visited on the 30.08.06) concludes:

“It has numerous potential in China’s coal mine methane mitigation. So far, less than 50% [the body of the text quotes 5.6%] of underground extraction methane annually have been comprehensively utilized. At present, methane drainage level, drainage rate and utilization rate in China are fairly low. Majorities of the methane extracted have been discharged to the air. Total drainage amount and utilization amount of coalbed methane [CMM] resources can be improved significantly and it will make important contributions to the business of methane mitigation under the premise of improving technology level and enhancing the management..... It is concluded that utilization of coal mine methane in China is not common practice is China.”

In 2002 only 196 coal mines in China had undertaken methane drainage. The average drainage rate in the country is less than 10%.<sup>3</sup> Moreover, less than 50% of China’s drained CMM was utilized, which means that only less than 5% of the total CMM emitted by China is being used at coal mines.

***Sub-step 4b. Discuss any similar options that are occurring***

In Shanxi province, there are several CMM power generation and utilization projects. All of them are implemented with CDM consideration.

**Table B.5-4**

| Project name  | Installation Capacity(MW) | Status     | CDM (Y/N) |
|---|---------------------------|------------|-----------|
| Yangquan Coal Mine Methane (CMM) Utilization for Power Generation Project, Shanxi Province, China | 90                        | Registered | Y         |
| Shanxi Coal Transport Market Ltd,. Co. Yangquan Branch CMM Utilization Project                    | 30                        | Registered | Y         |
| Shanxi Liulin Coal Mine Methane Utilization Project   | 12                        | Registered | Y         |

<sup>3</sup> China Coal Information Institute (CCII), *Optimal Projects for China’s Coal Mine Methane Mitigation*, 3rd International Methane & Nitrous Oxide Mitigation Conference, Beijing, China, November 2003



|   |      |            |   |
|---|------|------------|---|
| China Jincheng Sihe 120 MW Coal Mine Methane Power Generation Project | 120  | Registered | Y |
| Shanxi Yangcheng Coal Mine Methane Utilization Project                | 16.5 | Registered | Y |

Data Source: UNFCCC website

### B.6.1. Explanation of methodological choices:

#### Baseline emissions:

$$BE_y = BE_{MD,y} + BE_{MR,y} + BE_{Use,y} \quad (1)$$

Where

|              |   |
|--------------|---|
| $BE_y$       | Baseline emissions in year y (tCO <sub>2</sub> e)   |
| $BE_{MD,y}$  | Baseline emissions from destruction of methane in the baseline scenario in year y (tCO <sub>2</sub> e)                                      |
| $BE_{MR,y}$  | Baseline emissions from release of methane into the atmosphere in year y that is avoided by the project activity (tCO <sub>2</sub> e)       |
| $BE_{Use,y}$ | Baseline emissions from the production of power, heat or supply to gas grid replaced by the project activity in year y (tCO <sub>2</sub> e) |

$BE_{MD,y}$  (baseline emissions from the destruction of methane in the baseline scenario) are zero.

$$BE_{MR,y} = GWP_{CH_4} \times \left[ \sum_i (CBMe_{i,y} - CBM_{BLi,y}) + \sum_i (CMM_{PJi,y} - CMM_{BLi,y}) + \sum_i (PMM_{PJi,y} - PMM_{BLi,y}) \right] \quad (2)$$

Where,

|               |   |
|---------------|---|
| $BE_{MR,y}$   | Baseline emissions from release of methane into the atmosphere in year y that is avoided by the project activity (tCO <sub>2</sub> e)                       |
| I             | Use of methane (flaring, power generation, heat generation, supply to gas grid to various combustion end uses)  |
| $CBMe_{i,y}$  | Eligible CBM captured, sent to and destroyed by use <i>i</i> in the project for year y (expressed in tCH <sub>4</sub> ) = 0                                 |
| $CBM_{BLi,y}$ | CBM that would have been captured, sent to and destroyed by use <i>i</i> in the baseline scenario in the year y (expressed in tCH <sub>4</sub> ) = 0        |
| $CMM_{PJi,y}$ | Pre-mining CMM captured, sent to and destroyed by use <i>i</i> in the project activity in year y (expressed in tCH <sub>4</sub> )                           |
| $CMM_{BLi,y}$ | Pre-mining CMM that would have been captured, sent to and destroyed by use <i>i</i> in the baseline scenario in year y (expressed in tCH <sub>4</sub> ) = 0 |
| $PMM_{PJi,y}$ | post-mining CMM captured, sent to and destroyed by use <i>i</i> in the project activity in year y (tCH <sub>4</sub> )                                       |



$PMM_{BLi,y}$  post-mining CMM that would have been captured, sent to and destroyed by use  $i$  in the baseline scenario in year  $y$  ( $tCH_4$ ) = 0  
 $GWP_{CH_4}$  Global warming potential of methane (21  $tCO_2e/tCH_4$ )

In practice, the pre-mining and post-mining methane are indistinguishable, being extracted through the same pumping system in proportions that vary depending on mining activities, atmospheric pressure changes and day to day management of the ventilation systems

The baseline emissions are determined ex post by measuring the methane emitted from the methane drainage system at the point where it enters the equipment.

### Baseline emissions from grid power

The CEF\_electricity is calculated as per ACM0002, from the average of the operating margin and build margin in the North China Power Grid. The build margin is calculated from the newly installed capacity since 1999, which represents just over 20% of the total grid. Raw data is presented in Annex 3.

|        |        |                                    |
|--------|--------|------------------------------------|
| CEF_OM | 1.1208 | China Electric Power Yearbook 2006 |
| CEF_BM | 0.9397 | China Electric Power Yearbook 2006 |

According ACM0002, the baseline emission factor is the simple average of BM and OM:

$$1.1208 + 0.9397 / 2 = 1.03025$$

### Emission factor for heat generation

The baseline scenario includes existing heat generation that is replaced by the project activity. The Emissions Factor for displaced heat generation is calculated as follows:

$$EF_{heat,y} = \frac{EF_{CO_2,i}}{Eff_{heat}} \times \frac{44}{12} \times \frac{1TJ}{1000GJ} \quad (3)$$

where:

|               |   |
|---------------|---|
| $EF_{heat,y}$ | Emissions factor for heat generation ( $tCO_2/GJ$ )                 |
| $EF_{CO_2,i}$ | $CO_2$ emissions factor of fuel used in heat generation ( $tC/TJ$ ) |
| $Eff_{heat}$  | Boiler efficiency of the heat generation (%)                        |
| 44/12         | Carbon to Carbon Dioxide conversion factor                          |
| 1/1000        | TJ to GJ conversion factor  |

Boiler efficiency is taken as 100%

### Total emissions displaced by use of coal mine methane



There is no CBM

There is no vehicle fuel used by this project, and therefore  $VFUEL_y \times EF_V$  is not considered. Also, heat provided by the boilers is waste heat, and therefore creates zero emissions so  $EF_{HEAT}$  is also not considered. Therefore,  $PBE_{Use,y}$  is defined for this project as:

$$PBE_{Use,y} = GEN_y \times EF_{ELEC} + HEAT_y \times EF_{HEAT} \quad (5)$$

Where,

|               |   |
|---------------|---|
| $PBE_{Use,y}$ | Potential total baseline emissions from the production of power or heat replaced by the project activity in year y (tCO <sub>2</sub> e) |
| $GEN_y$       | Electricity generated by project activity in year y (MWh), including through the use of CBM   |
| $EF_{ELEC}$   | Emissions factor of electricity (grid, captive or a combination) replaced by project (tCO <sub>2</sub> /MWh) = 1.03025 (see above)      |
| $HEAT_y$      | Heat generation by project activity in year y (GJ), including through the use of CBM  |

$$ER_y = BE_y - PE_y - Ly \quad (6)$$

Where

$ER_y$  = Emission reduction in year y

$BE_y$  = baseline emissions in year y

$PE_y$  = project emissions in year y

$Ly$  = Leakage in year y = 0

### Project emissions:

$$PE_y = PE_{ME} + PE_{MD} + PE_{UM} \quad (9)$$

where:

|           |   |
|-----------|---|
| $PE_y$    | Project emissions in year y (tCO <sub>2</sub> e)                                  |
| $PE_{ME}$ | Project emissions from energy use to capture and use methane (tCO <sub>2</sub> e) |
| $PE_{MD}$ | Project emissions from methane destroyed (tCO <sub>2</sub> e)                     |
| $PE_{UM}$ | Project emissions from un-combusted methane (tCO <sub>2</sub> e)                  |

$PE_{ME} = 0$  because the project activity simply takes the methane already captured and released in the baseline scenario. No additional energy is utilised.



$$PE_{MD} = (MD_{FL} + MD_{ELEC} + MD_{HEAT} + MD_{GAS}) \times ((1-r) \times CEF_{CH_4} + r \times CEF_{NMHC}) \quad (10)^4$$

with:

$$r = PC_{NMHC} / PC_{CH_4} \quad (11)$$

where:<sup>5</sup>

|              |   |
|--------------|---|
| $PE_{MD}$    | Project emissions from CMM/CBM destroyed (tCO <sub>2</sub> e)   |
| $MD_{FL}$    | Methane destroyed through flaring (tCH <sub>4</sub> )   |
| $MD_{ELEC}$  | Methane destroyed through power generation (tCH <sub>4</sub> )  |
| $MD_{HEAT}$  | Methane destroyed through heat generation (tCH <sub>4</sub> ) = 0   |
| $MD_{GAS}$   | Methane destroyed after being supplied to gas grid or for vehicle use (tCH <sub>4</sub> ) = 0   |
| $CEF_{CH_4}$ | Carbon emission factor for combusted methane (2.75 tCO <sub>2</sub> e/tCH <sub>4</sub> )  |
| $CEF_{NMHC}$ | Carbon emission factor for combusted non methane hydrocarbons (the concentration varies and, therefore, to be obtained through periodical analysis of captured methane) (tCO <sub>2</sub> eq/tNMHC) |
| $r$          | Relative proportion of NMHC compared to methane   |
| $PC_{CH_4}$  | Concentration (in mass) of methane in extracted gas (%)   |
| $PC_{NMHC}$  | NMHC concentration (in mass) in extracted gas (%)   |

Not all of the methane sent to generate power, flare and heat will be combusted, so a small amount will escape to the atmosphere. These emissions are calculated using the following:

$$PE_{UM} = GWP_{CH_4} \times \sum_i MM_i \times (1 - Eff_i) \quad (12)$$

where:

|              |  |
|--------------|--|
| $PE_{UM}$    | Project emissions from un-combusted methane (tCO <sub>2</sub> e)   |
| $GWP_{CH_4}$ | Global warming potential of methane (21 tCO <sub>2</sub> e/tCH <sub>4</sub> )                                  |
| $I$          | Use of methane (flaring, power generation, heat generation, supply to gas grid to various combustion end uses) |
| $MM_i$       | Methane measured sent to use i (tCH <sub>4</sub> )   |
| $Eff_i$      | Efficiency of methane destruction in use i (%)   |

$Eff_{ELEC}$  (Efficiency of methane destruction/oxidation in power plant) will be taken as 99.5% from the 2006 Revised IPCC Guidelines for efficiency of methane oxidation/destruction in a power plant and as proscribed by to ACM0008 version 03.

### Leakage:

<sup>4</sup> A factor of (1-r) is included to correctly weight the CEF by percentage of the respective gases

<sup>5</sup> Note that throughout this baseline methodology, it is assumed that measured quantities of coal mine gas are converted to tonnes of methane using the measured methane concentration of the coal mine gas and the density of methane.



ACM0008 requires consideration of leakage from two sources: Leakage emissions due to displacement of other baseline thermal energy uses of methane in year  $y$  ( $tCO_2e$ ) and leakage emissions due to other uncertainties in year  $y$  ( $tCO_2e$ ).

There is no baseline thermal energy use therefore there is no leakage to consider in this category. As discussed above, the project will not have any direct impact upon coal production. Since it has no direct impact upon coal production, the project activity is not expected to have any impact upon coal prices and market dynamics. The project does not involve any CBM.

**To determine project emissions from flaring gases containing methane**

For the enclosed flares, the following option will be used to determine the flare efficiency:

(a) To use a 90% default value. Continuous monitoring of compliance with manufacturer's specification of flare (temperature, flow rate of residual gas at the inlet of the flare) must be performed. If in a specific hour any of the parameters are out of the limit of manufacturer's specifications, a 50% default value for the flare efficiency should be used for the calculations for this specific hour.

Applicable steps include:

STEP 1: Determination of the mass flow rate of the residual gas that is flared

STEP 2: Determination of the mass fraction of carbon, hydrogen, oxygen and nitrogen in the residual gas

STEP 5: Determination of methane mass flow rate of the residual gas on a dry basis

STEP 6: Determination of the hourly flare efficiency

STEP 7: Calculation of annual project emissions from flaring based on measured hourly values or based on default flare efficiencies.

**STEP 1. Determination of the mass flow rate of the residual gas that is flared**

This step calculates the residual gas mass flow rate in each hour  $h$ , based on the volumetric flow rate and the density of the residual gas. The density of the residual gas is determined based on the volumetric fraction of all components in the gas.

$$FM_{RG,h} = \rho_{RG,n,h} \times FV_{RG,h} \quad (1)$$

Where:

| Variable        | SI Unit           | Description  |
|-----------------|-------------------|--|
| $FM_{RG,h}$     | kg/h              | Mass flow rate of the residual gas in hour $h$   |
| $\rho_{RG,n,h}$ | kg/m <sup>3</sup> | Density of the residual gas at normal conditions in hour $h$                               |
| $FV_{RG,h}$     | m <sup>3</sup> /h | Volumetric flow rate of the residual gas in dry basis at normal conditions in the hour $h$ |

and:



and:

$$\rho_{RG,n,h} = \frac{P_n}{\frac{R_u}{MM_{RG,h}} \times T_n} \quad (2)$$

Where:

| Variable        | SI Unit                   | Description   |
|-----------------|---------------------------|---|
| $\rho_{RG,n,h}$ | kg/m <sup>3</sup>         | Density of the residual gas at normal conditions in hour <i>h</i> |
| $P_n$           | Pa                        | Atmospheric pressure at normal conditions (101 325)               |
| $R_u$           | Pa.m <sup>3</sup> /kmol.K | Universal ideal gas constant (8 314)                              |
| $MM_{RG,h}$     | kg/kmol                   | Molecular mass of the residual gas in hour <i>h</i>               |
| $T_n$           | K                         | Temperature at normal conditions (273.15)                         |

and:

$$MM_{RG,h} = \sum_i (fv_{i,h} * MM_i) \quad (3)$$

Where:

| Variable    | SI Unit | Description   |
|-------------|---------|---|
| $MM_{RG,h}$ | kg/kmol | Molecular mass of the residual gas in hour <i>h</i>   |
| $fv_{i,h}$  | -       | Volumetric fraction of component <i>i</i> in the residual gas in the hour <i>h</i>                      |
| $MM_i$      | kg/kmol | Molecular mass of residual gas component <i>i</i>   |
| $I$         |         | The components CH <sub>4</sub> , CO, CO <sub>2</sub> , O <sub>2</sub> , H <sub>2</sub> , N <sub>2</sub> |

## STEP 2. Determination of the mass fraction of carbon, hydrogen, oxygen and nitrogen in the residual gas

Determine the mass fractions of carbon, hydrogen, oxygen and nitrogen in the residual gas, calculated from the volumetric fraction of each component *i* in the residual gas, as follows:



$$fm_{j,h} = \frac{\sum_i fv_{i,h} \cdot AM_j \cdot NA_{j,i}}{MM_{RG,h}} \quad (4)$$

Where:

| Variable    | SI Unit | Description  |
|-------------|---------|--|
| $fm_{j,h}$  | -       | Mass fraction of element $j$ in the residual gas in hour $h$             |
| $fv_{i,h}$  | -       | Volumetric fraction of component $i$ in the residual gas in the hour $h$ |
| $AM_j$      | kg/kmol | Atomic mass of element $j$   |
| $NA_{j,i}$  | -       | Number of atoms of element $j$ in component $i$                          |
| $MM_{RG,h}$ | kg/kmol | Molecular mass of the residual gas in hour $h$                           |
| $j$         |         | The elements carbon, hydrogen, oxygen and nitrogen                       |
| $i$         |         | The components $CH_4$ , $CO$ , $CO_2$ , $O_2$ , $H_2$ , $N_2$            |

#### STEP 5. Determination of methane mass flow rate in the residual gas on a dry basis

The quantity of methane in the residual gas flowing into the flare is the product of the volumetric flow rate of the residual gas ( $FV_{RG,h}$ ), the volumetric fraction of methane in the residual gas ( $fv_{CH_4, RG, h}$ ) and the density of methane ( $\rho_{CH_4, n, h}$ ) in the same reference conditions (normal conditions and dry or wet basis). It is necessary to refer both measurements (flow rate of the residual gas and volumetric fraction of methane in the residual gas) to the same reference condition that may be dry or wet basis. If the residual gas moisture is significant (temperature greater than 60°C), the measured flow rate of the residual gas that is usually referred to wet basis should be corrected to dry basis due to the fact that the measurement of methane is usually undertaken on a dry basis (i.e. water is removed before sample analysis).

$$TM_{RG,h} = FV_{RG,h} \times fv_{CH_4, RG, h} \times \rho_{CH_4, n} \quad (13)$$

Where:

| Variable           | SI Unit           | Description  |
|--------------------|-------------------|--|
| $TM_{RG,h}$        | kg/h              | Mass flow rate of methane in the residual gas in the hour $h$  |
| $FV_{RG,h}$        | m <sup>3</sup> /h | Volumetric flow rate of the residual gas in dry basis at normal conditions in hour $h$   |
| $fv_{CH_4, RG, h}$ | -                 | Volumetric fraction of methane in the residual gas on dry basis in hour $h$ (NB: this corresponds to $fv_{i, RG, h}$ where $i$ refers to methane). |
| $\rho_{CH_4, n}$   | kg/m <sup>3</sup> | Density of methane at normal conditions (0.716)  |

#### STEP 6. Determination of the hourly flare efficiency

In case of **enclosed flares and use of the default value** for the flare efficiency, the flare efficiency in the hour  $h$  ( $h_{flare, h}$ ) is:





- 0% if the temperature in the exhaust gas of the flare ( $T_{flare}$ ) is below 500 °C for more than 20 minutes during the hour  $h$ .
- 50%, if the temperature in the exhaust gas of the flare ( $T_{flare}$ ) is above 500 °C for more than 40 minutes during the hour  $h$ , but the manufacturer's specifications on proper operation of the flare are not met at any point in time during the hour  $h$ .
- 90%, if the temperature in the exhaust gas of the flare ( $T_{flare}$ ) is above 500 °C for more than 40 minutes during the hour  $h$  and the manufacturer's specifications on proper operation of the flare are met continuously during the hour  $h$ .

### STEP 7. Calculation of annual project emissions from flaring

Project emissions from flaring are calculated as the sum of emissions from each hour  $h$ , based on the methane flow rate in the residual gas ( $TM_{RG,h}$ ) and the flare efficiency during each hour  $h$  ( $\eta_{flare,h}$ ), as follows:

$$PE_{flare,y} = \sum_{h=1}^{8760} TM_{RG,h} \times (1 - \eta_{flare,h}) \times \frac{GWP_{CH_4}}{1000} \quad (15)$$

Where:

| Variable         | SI Unit                             | Description   |
|------------------|-------------------------------------|---|
| $PE_{flare,y}$   | tCO <sub>2</sub> e                  | Project emissions from flaring of the residual gas stream in year $y$ |
| $TM_{RG,h}$      | kg/h                                | Mass flow rate of methane in the residual gas in the hour $h$         |
| $\eta_{flare,h}$ | -                                   | Flare efficiency in hour $h$  |
| $GWP_{CH_4}$     | tCO <sub>2</sub> e/tCH <sub>4</sub> | Global Warming Potential of methane valid for the commitment period   |

### Emission Reductions:

Emission reductions due to the project activity are determined by subtracting the project emissions during period  $y$  from the baseline emissions during the same period  $y$ :

$$ER_y = BE_y - PE_y - LE_y \quad (13)$$

where:

|        |   |
|--------|---|
| $ER_y$ | Emissions reductions of the project activity during the year $y$ (tCO <sub>2</sub> e) |
| $BE_y$ | baseline emissions during the year $y$ (tCO <sub>2</sub> e)                           |
| $PE_y$ | project emissions during the year $y$ (tCO <sub>2</sub> e)                            |
| $LE_y$ | leakage emissions in year $y$ (tCO <sub>2</sub> e) = 0                                |

### B.6.2. Data and parameters that are available at validation:

|                          |   |
|--------------------------|---|
| <b>Data / Parameter:</b> | <b>CEF – CH<sub>4</sub></b>                 |
| Data unit:               | tCO <sub>2</sub> e/tCH <sub>4</sub>         |
| Description:             | Carbon emission factor of coal mine methane |



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|   |                                  |
|---|----------------------------------|
| Source of data used:  | 2006 Revised Guidelines for IPCC |
| Value applied:  | 2.75                             |
| Justification of the choice of data or description of measurement methods and procedures actually applied : | Stoichiometric calculation       |
| Any comment:  | No comment                       |

|   |   |
|---|---|
| <b>Data / Parameter:</b>  | <b>CEFelecpj</b>                            |
| Data unit:  | tCO <sub>2</sub> e/tCH <sub>4</sub>         |
| Description:  | Carbon emission factor of coal mine methane |
| Source of data used:  | 2006 Revised Guidelines for IPCC            |
| Value applied:  | 2.75  |
| Justification of the choice of data or description of measurement methods and procedures actually applied : | Stoichiometric calculation                  |
| Any comment:  | No comment                                  |

|   |   |
|---|---|
| <b>Data / Parameter:</b>  | <b>EF co<sub>2</sub></b>                    |
| Data unit:  | tCO <sub>2</sub> e/tCH <sub>4</sub>         |
| Description:  | Carbon emission factor of coal mine methane |
| Source of data used:  | 2006 Revised Guidelines for IPCC            |
| Value applied:  | 2.75  |
| Justification of the choice of data or description of measurement methods and procedures actually applied : | Stoichiometric calculation                  |
| Any comment:  | No comment                                  |

|   |                                     |
|---|-------------------------------------|
| <b>Data / Parameter:</b>  | <b>GWP – CH<sub>4</sub></b>         |
| Data unit:  | tCO <sub>2</sub> e/tCH <sub>4</sub> |
| Description:  | Global warming potential of methane |
| Source of data used:  | 2006 Revised Guidelines IPCC        |
| Value applied:  | 21                                  |
| Justification of the choice of data or description of measurement methods and procedures actually applied : | Default value                       |



|              |            |
|--------------|------------|
| applied :    |            |
| Any comment: | No comment |

|   |   |
|---|---|
| <b>Data / Parameter:</b>  | <b>PCnmhc</b>   |
| Data unit:  | %   |
| Description:  | Percentage of non-methane hydrocarbon in methane  |
| Source of data used:  | Periodic analysis   |
| Value applied:  | 0 (zero)  |
| Justification of the choice of data or description of measurement methods and procedures actually applied : | Tests performed by TES Bretby in UK on four tube samples collected from the mine in August 2006 recorded levels of 0.02% or less for all non-methane hydrocarbons (Appendix 2).<br>Samples will be re-analysed annually and if more than the concentrations of all NMHCs combined exceed 1%, they will be incorporated in the calculations. |
| Any comment:  | No comment  |

|   |   |
|---|---|
| <b>Data / Parameter:</b>  | <b>CEFnmhc</b>  |
| Data unit:  | tCO <sub>2</sub> /tnmhc   |
| Description:  | Carbon emission factor per tonnes of non-methane hydrocarbon  |
| Source of data used:  | Stoichiometric analysis   |
| Value applied:  | Depends on type of hydrocarbon. Calculated dividing the molecular weight of CO <sub>2</sub> produced by the molecular weight the hydrocarbon. For example, 1 mole of C <sub>3</sub> H <sub>8</sub> (propane) with MW 44 yields 3 moles of CO <sub>2</sub> with MW 68. CEF = $3 \times 44 / 44 = 3$ tonnes of CO <sub>2</sub> per tonne of C <sub>3</sub> H <sub>8</sub> . |
| Justification of the choice of data or description of measurement methods and procedures actually applied : | Stoichiometric calculation  |
| Any comment:  | No comment  |

|   |                                       |
|---|---------------------------------------|
| <b>Data / Parameter:</b>  | <b>EFelec</b>                         |
| Data unit:  | tCO <sub>2</sub> /MWh                 |
| Description:  | Baseline emissions from grid power    |
| Source of data used:  | Calculated from NDRC Values           |
| Value applied:  | 1.03205                               |
| Justification of the choice of data or description of measurement methods and procedures actually applied : | Calculated using ACM0002. See Annex 3 |
| Any comment:  | No comment                            |



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|   |   |
|---|---|
| <b>Data / Parameter:</b>  | <b>EF<sub>OM</sub>; EF<sub>BM</sub>; F<sub>ijv</sub>; COEF<sub>ik</sub>; GEN<sub>i</sub></b>                  |
| Data unit:  | Various   |
| Description:  | EF for operating and build margins; fuel used to produce power; emission factor of each fuel; power generated |
| Source of data used:  | China Electric Power Yearbook(s)  |
| Value applied:  | Various – see Annex 3   |
| Justification of the choice of data or description of measurement methods and procedures actually applied : | Calculated using ACM0002. See Annex 3   |
| Any comment:  | No comment  |

|   |   |
|---|---|
| <b>Data / Parameter:</b>  | <b>EF<sub>i</sub></b>   |
| Data unit:  | tCO <sub>2</sub> /GJ  |
| Description:  | Emission factor of fuel used for captive power / heat generation  |
| Source of data used:  | IPCC GHG Inventory reference Manual Vol 3   |
| Value applied:  | 0.094   |
| Justification of the choice of data or description of measurement methods and procedures actually applied : | Conservative emission factor of 25.65 TC/TJ = 0.02565 TC/GJ<br>0.02565 * 44/12 = 0.0940 TCO <sub>2</sub> per GJ |
| Any comment:  | No comment  |

|   |  |
|---|--|
| <b>Data / Parameter:</b>  | <b>Eff<sub>ELEC</sub></b>                                    |
| Data unit:  | percentage   |
| Description:  | Efficiency of methane destruction / oxidation in power plant |
| Source of data used:  | ACM0008 ver 3  |
| Value applied:  | 99.5%  |
| Justification of the choice of data or description of measurement methods and procedures actually applied : | ACM0008 ver 3 specifies this value to be applied             |
| Any comment:  | No comment   |

|                          |  |
|--------------------------|--|
| <b>Data / Parameter:</b> | <b>Eff<sub>i</sub></b>   |
| Data unit:               | Percentage   |
| Description:             | Efficiency of methane destruction / oxidation in use i (in this case, flaring) |
| Source of data used:     | ACM0008 ver 3  |
| Value applied:           | 90%  |
| Justification of the     | According to the Tool to determine project emissions from flaring gases        |



|  |                     |
|--|---------------------|
| choice of data or description of measurement methods and procedures actually applied : | containing methane. |
| Any comment:   | n/a                 |

### B.6.3 Ex-ante calculation of emission reductions:

Ex-ante calculations have been made for year 1, 2 and 3 only. Values and calculations from year 4 onward are the same as year 3.

#### I. Estimated baseline emissions

##### A) Determination of baseline emissions from destruction of methane in the baseline scenario ( $BE_{MD,y}$ )

Since there exist no methane destruction prior to the implementation of the Project in Duerping Coal Mine, methane destruction in the baseline is zero, i.e.  $BE_{MD,y}=0$ .

##### B) Determination of baseline emissions from release of methane into the atmosphere that is avoided by the project activity ( $BE_{MR,y}$ )

| Item                                | $GWP_{CH_4}$<br>(tCO <sub>2</sub> e/tCH <sub>4</sub> ) | $CMM_{tot,y}$<br>(tCH <sub>4</sub> /yr) | $BE_{MR,y}$<br>(tCO <sub>2</sub> e/yr) |
|-------------------------------------|--|---|--|
| I.D.                                | A  | B                                       | C                                      |
| Data for Year 1(Oct-Dec)            | 21   | 15,844                                  | 142,590                                |
| Year 2                              |  |   | 285,201                                |
| Year 3                              |  |   | 332,724                                |
| Data source or calculation formulae | ACM0008  | the feasibility study report            | C=A×B                                  |

##### C) Determination of baseline emissions from the production of power or heat replaced by the project activity ( $BE_{Use,y}$ )

| Item            | $CEF_{CH_4}$<br>(MW) | Working hours<br>(h) | $EF_{ELEC}$<br>(tCO <sub>2</sub> e/MWh) | $HEAT_y$<br>(GJ/yr)    |
|-----------------|----------------------|----------------------|---|------------------------|
| I.D.            | D                    | E                    | F                                       | G                      |
| Data for Year 1 | 2.75                 | 7000                 | 1.03025                                 | 55,188                 |
| Year 2          |                      |                      |   |                        |
| Year 3          |                      |                      |   |                        |
| Data source or  | IPCC 2006            | IPCC 2006            | Notification on Determining             | See Annex 3 for detail |



|                      |  |  |  |  |
|----------------------|--|--|--|--|
| calculation formulae |  |  | Baseline Emission Factor of China's Grid |  |
|----------------------|--|--|--|--|

| Item                                | $EF_{CO_2,i}$<br>(tCO <sub>2</sub> e/tCH <sub>4</sub> ) | $Eff_{ELEC}$<br>(%) | $EF_{heat,y}$<br>(tCO <sub>2</sub> e/GJ) | $BE_{Use,y}$<br>(tCO <sub>2</sub> e/yr) |
|-------------------------------------|---|---------------------|--|---|
| I.D.                                | H   | I                   | J  | K                                       |
| Data for Year 1                     | 2.75  | 99.5                | 0.0946                                   | 42,001                                  |
| Year 2                              |   |                     |  | 78,781                                  |
| Year 3                              |   |                     |  | 91,041                                  |
| Data source or calculation formulae | IPCC 2006   | ACM0008             | ACM0008                                  | $K=(MW \times E) \times F + G \times J$ |

## II. Estimated project emissions

### A) Project emissions from energy use to capture and use methane ( $PE_{ME}$ )

| Item                                | $CONS_{ELEC,PJ}$<br>(MWh/yr)  | $PE_{ME}$<br>(tCO <sub>2</sub> e/yr) |
|-------------------------------------|---|--------------------------------------|
| I.D.                                | L   | M                                    |
| Data for Year 1                     | 0   | 0                                    |
| Year 2                              |   |                                      |
| Year 3                              |   |                                      |
| Data source or calculation formulae | Methane capturing system is in the baseline and power meters of generators show net not gross power produced. | $M=L \times F$                       |

### B) Project emissions from methane destroyed ( $PE_{MD}$ )

| Item            | $PE_{MD}$ (tCO <sub>2</sub> e/yr) |
|-----------------|-----------------------------------|
| I.D.            | N                                 |
| Data for Year 1 | 18,579                            |
| Year 2          | 37,161                            |
| Year 3          | 43,353                            |
| Data source or  | $N= B \times I \times J$          |



|                      |  |
|----------------------|--|
| calculation formulae |  |
|----------------------|--|

**C) Project emissions from un-combusted methane ( $PE_{UM}$ )**

| Item                                | $PE_{UM}$ (tCO <sub>2</sub> e/yr) |
|-------------------------------------|-----------------------------------|
| I.D.                                | O                                 |
| Data for Year 1                     | 713                               |
| Year 2                              | 1,426                             |
| Year 3                              | 1,664                             |
| Data source or calculation formulae | $O=C \times (1-I)$                |

**III. Estimated leakage**

According to the consolidated baseline methodology ACM0008, no leakage is considered in the Project (see Section B.6.1. for details).

**IV. Estimated emission reductions**

| Item                                | $BE_y$ (tCO <sub>2</sub> e/yr) | $PE_y$ (tCO <sub>2</sub> e/yr) | $L_y$ (tCO <sub>2</sub> e/yr) | $ER_y$ (tCO <sub>2</sub> e/yr) |
|-------------------------------------|--------------------------------|--------------------------------|-------------------------------|--------------------------------|
| I.D.                                | P                              | Q                              | R                             | S                              |
| Data for Year 1                     | 184,591                        | 19,292                         | 0                             | 165,299                        |
| Year 2                              | 363,982                        | 38,587                         |                               | 325,395                        |
| Year 3                              | 423,765                        | 45,017                         |                               | 378,748                        |
| Data source or calculation formulae | $P=C+K$                        | $Q=M+N+O$                      | ACM0008                       | $S=P-Q-R$                      |

**B.6.4 Summary of the ex-ante estimation of emission reductions:**

| Year        | Estimation of project activity emissions (tonnes CO <sub>2</sub> e) | Estimation of baseline emissions (tonnes CO <sub>2</sub> ) | Estimation of leakage (tonnes CO <sub>2</sub> e) | Estimation of overall emission reductions (tonnes CO <sub>2</sub> e) |
|-------------|---|--|--|--|
| 1 (Oct-Dec) | 4,823   | 46,147   | 0  | 41,325   |



|              |         |           |   |           |
|--------------|---------|-----------|---|-----------|
| 2            | 38,587  | 363,982   | 0 | 325,395   |
| 3            | 45,017  | 423,765   | 0 | 378,748   |
| 4            | 45,017  | 423,765   | 0 | 378,748   |
| 5            | 45,017  | 423,765   | 0 | 378,748   |
| 6            | 45,017  | 423,765   | 0 | 378,748   |
| 7            | 45,017  | 423,765   | 0 | 378,748   |
| 8            | 45,017  | 423,765   | 0 | 378,748   |
| 9            | 45,017  | 423,765   | 0 | 378,748   |
| 10           | 45,017  | 423,765   | 0 | 378,748   |
| 11 (Jan-Sep) | 33,763  | 317,824   | 0 | 284,061   |
| Total        | 437,309 | 4,118,073 | 0 | 3,680,764 |

**B.7 Application of the monitoring methodology and description of the monitoring plan:**
**B.7.1 Data and parameters monitored:**

| <b>Data / Parameter:</b>   | <b>PEy</b>  |
|--|---|
| Data unit:   | T CO <sub>2</sub>   |
| Description:   | Project emissions in period y   |
| Source of data to be used:   | Calculated from sum of emissions from combustion of methane and emissions of un-combusted methane   |
| Value of data applied for the purpose of calculating expected emission reductions in section B.5 | 2.75 t CO <sub>2</sub> per tonne of methane combusted plus 0.005 t CO <sub>2</sub> per tonne of methane burnt in the generators from un-combusted methane   |
| Description of measurement methods and procedures to be applied:                                 | See PE <sub>md</sub> and PE <sub>um</sub> below   |
| QA/QC procedures to be applied:  | Calculations will be performed by spreadsheet which will be audited periodically and protected from being over-written or altered by unauthorized personnel. Data will be backed up and archived in two different locations, where it will be stored for the longer of two years longer than the crediting period or two years after the last issuance of CERs.<br>Actual project emissions will be compared with predicted project emissions at the prevailing generation capacity as a logic check. |
| Any comment:   | No comment  |

| <b>Data / Parameter:</b> | <b>PEme</b>  |
|--------------------------|--|
| Data unit:               | TCO <sub>2</sub>   |
| Description:             | Project emissions from energy use to capture and use methane |
| Source of data to be     | n/a  |





|  |   |
|--|---|
| used:  |   |
| Value of data applied for the purpose of calculating expected emission reductions in section B.5 | n/a   |
| Description of measurement methods and procedures to be applied:                                 | n/a   |
| QA/QC procedures to be applied:  | n/a   |
| Any comment:   | No additional energy is used. Capture and removal of methane is the business as usual scenario. |

|  |  |
|--|--|
| <b>Data / Parameter:</b>   | <b>PEmd</b>  |
| Data unit:   | tCO <sub>2</sub>   |
| Description:   | Project emissions from destruction of methane  |
| Source of data to be used:   | Calculated from volume of methane at normal temperature and pressure combusted by generators multiplied by 2.75.   |
| Value of data applied for the purpose of calculating expected emission reductions in section B.5 | Ex ante volume of methane consumed is in Nm <sup>3</sup> , therefore no conversion is necessary before applying the density. For the ex ante prediction no conversion for NTP is required, but ex post, temperature and pressure will be recorded and the volume adjusted to NTP using the gas law $P_1V_1/T_1=P_2V_2/T_2$   |
| Description of measurement methods and procedures to be applied:                                 | Volume of pure methane destroyed is calculated from volume and concentration measurements taken at the inlet to the generators. See MDelec below   |
| QA/QC procedures to be applied:  | Calculations will be performed by spreadsheet which will be audited periodically and protected from being over-written or altered by unauthorized personnel. Data will be backed up and archived in two different locations, where it will be stored for the longer of two years longer than the crediting period or two years after the last issuance of CERs.<br>The volume of methane destroyed will be cross checked by correlation with gross power output from the generators. |
| Any comment:   | No comment   |

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|--|--|
| <b>Data / Parameter:</b>   | <b>PEum</b>  |
| Data unit:   | T CO <sub>2</sub> e  |
| Description:   | Un-combusted methane emitted from the generators                           |
| Source of data to be used:   | Calculated from mass of methane burnt in generators                        |
| Value of data applied for the purpose of calculating expected emission reductions in | Default efficiency is 99.5%, therefore un-combusted methane is 0.05 * PEmd |



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| section B.5  |  |
| Description of measurement methods and procedures to be applied: | See PEmd above   |
| QA/QC procedures to be applied:                                  | Calculations will be performed by spreadsheet which will be audited periodically and protected from being over-written or altered by unauthorized personnel. Data will be backed up and archived in two different locations, where it will be stored for the longer of two years longer than the crediting period or two years after the last issuance of CERs.<br>Application of a constant so no measurement necessary |
| Any comment:   | No comment   |

|  |  |
|--|--|
| <b>Data / Parameter:</b>   | <b>MDelec</b>  |
| Data unit:   | T CH4  |
| Description:   | Methane destroyed by power generators  |
| Source of data to be used:   | Calculated from the flow and concentration of methane at the inlet to the generators.  |
| Value of data applied for the purpose of calculating expected emission reductions in section B.5 | Based on specifications of generators which consume 6.75 Nm <sup>3</sup> of pure methane per minute, density 0.00067 t/m <sup>3</sup> at NTP for an average of 7000 hours per year, each 1.7 MW generator will consume 1331.42 tonnes of methane per year, of which 0.5% (10 tonnes) will be emitted un-combusted.   |
| Description of measurement methods and procedures to be applied:                                 | See MMelec and PC CH4  |
| QA/QC procedures to be applied:  | Calculations will be performed by spreadsheet which will be audited periodically and protected from being over-written or altered by unauthorized personnel. Data will be backed up and archived in two different locations, where it will be stored for the longer of two years longer than the crediting period or two years after the last issuance of CERs.<br>The volume of methane destroyed will be correlated with gross power output from the generators. |
| Any comment:   |  |

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|----------------------------|---|
| <b>Data / Parameter:</b>   | <b>MMelec</b>   |
| Data unit:                 | M3  |
| Description:               | Volume of methane combusted for electricity generation  |
| Source of data to be used: | Measured by a flow meter on the inlet to each generator and summed. For the ex ante prediction on conversion for NTP (given by the methodology as 0.67 kg/m <sup>3</sup> ) is required, but ex post, temperature and pressure will be recorded and the volume adjusted to NTP using the gas law $P_1V/T_1 = P_2V_2/T_2$ |
| Value of data applied      | Based on generator specifications of 6.75 Nm <sup>3</sup> of pure methane per minute  |



|  |  |
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| for the purpose of calculating expected emission reductions in section B.5 | (equivalent to 270 NM <sup>3</sup> /h per MW)  |
| Description of measurement methods and procedures to be applied:           | A flow meter will be used to determine flow to all generator sets. For cross checking purposes the generator sets will be fitted with individual flow meters (differential pressure, turbine or flow meter). Measurements will be taken continuously and logged at nominal 30 second intervals.  |
| QA/QC procedures to be applied:  | Data will be backed up and archived in two different locations, where it will be stored for the longer of two years longer than the crediting period or two years after the last issuance of CERs.<br>Flow meters will be calibrated and monitored according to the manufacturer's specifications.<br>Total flow to the generators will be checked against mine methane drainage data. |
| Any comment:   | No comment   |

|  |   |
|--|---|
| <b>Data / Parameter:</b>   | <b>Effelec</b>  |
| Data unit:   | %   |
| Description:   | Efficiency of combustion of methane in power generators   |
| Source of data to be used:   | Default taken from methodology  |
| Value of data applied for the purpose of calculating expected emission reductions in section B.5 | 99.5%   |
| Description of measurement methods and procedures to be applied:                                 | N/A   |
| QA/QC procedures to be applied:  | This figure will be built into a spreadsheet for calculating emissions. The spreadsheet will be archived periodically and stored in two locations. Access to this figure will be controlled. This is a constant so no measurement uncertainty |
| Any comment:   | No comment  |

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|--|---|
| <b>Data / Parameter:</b>   | <b>CEF-nmhc</b>   |
| Data unit:   | T CO <sub>2</sub> / T NMHC  |
| Description:   | Carbon emission factor for non-methane hydrocarbons.  |
| Source of data to be used:   | If necessary, the value for specific non-methane hydrocarbons will be determined by stoichiometric calculation.   |
| Value of data applied for the purpose of calculating expected emission reductions in section B.5 | Not applicable at this stage because the sum of all non-methane hydrocarbons in gas samples is less than 1% and therefore can be ignored. (See results of gas analysis in Appendix 2) |
| Description of measurement methods   | Derived using measurements described in PCnmhc  |



|                                 |            |
|---------------------------------|------------|
| and procedures to be applied:   |            |
| QA/QC procedures to be applied: | n/a        |
| Any comment:                    | No comment |

|  |  |
|--|--|
| <b>Data / Parameter:</b>   | <b>PC CH4</b>  |
| Data unit:   | %  |
| Description:   | Percentage of pure methane (wet basis) in drained gas (by volume)  |
| Source of data to be used:   | Methanometer at the inlet to each generator  |
| Value of data applied for the purpose of calculating expected emission reductions in section B.5 | This figure is not used in the ex ante calculations however, in order for the generators to operate, the methane concentration must be above 30%.  |
| Description of measurement methods and procedures to be applied:                                 | Methane concentration will be measured by proprietary infra red instrumentation mounted in the gas pipework at the gas treatment unit and the generator sets. Accuracy of analysis +/-2.5%FSD. Gas analysed as sample (gas dried by pre-treatment). Measurements will be taken continuously and logged at nominal 30 second intervals.   |
| QA/QC procedures to be applied:  | Data will be backed up and archived in two different locations, where it will be stored for the longer of two years longer than the crediting period or two years after the last issuance of CERs.<br>Methanometers will be calibrated and monitored according to the manufacturer's specifications.<br>Methane purity to the generators will be checked against mine methane drainage data. |
| Any comment:   | No comment   |

|  |  |
|--|--|
| <b>Data / Parameter:</b>   | <b>PCnmhc</b>  |
| Data unit:   | %  |
| Description:   | Percentage of non-methane hydrocarbons in CMM, by mass   |
| Source of data to be used:   | Will be determined from annual tests of samples of coal mine methane   |
| Value of data applied for the purpose of calculating expected emission reductions in section B.5 | Not applicable at this stage because the sum of all non-methane hydrocarbons in gas samples is less than 1% and therefore can be ignored.  |
| Description of measurement methods and procedures to be applied:                                 | Annually, samples of gas will be extracted into gas sampling bottles using the appropriate procedures and analyzed by an qualified laboratory, for example, TES Bretby in the UK or an equivalent qualified laboratory in China. |



|                                 |   |
|---------------------------------|---|
| QA/QC procedures to be applied: | A minimum of 3 samples will be collected in secure gas sample vessels, suitable for storage and transport to the selected laboratory. Samples will be taken in accordance with protocol procedures in the CDM monitoring manual and analysed in a qualified laboratory. If one or more samples are found to be faulty (i.e. leaked) replacement samples will be taken. Scanned copies of the analyses will be backed up and archived in two different locations, where they will be stored for the longer of two years longer than the crediting period or two years after the last issuance of CERs. |
| Any comment:                    | No comment  |

|  |  |
|--|--|
| <b>Data / Parameter:</b>   | <b>R</b>   |
| Data unit:   | Ratio  |
| Description:   | Relative proportion of NMHC to methane   |
| Source of data to be used:   | Calculated from PC nmhc / PC CH4   |
| Value of data applied for the purpose of calculating expected emission reductions in section B.5 | Not applicable at this stage because the sum of all non-methane hydrocarbons in gas samples is less than 1% and therefore can be ignored.  |
| Description of measurement methods and procedures to be applied:                                 | See PC nmhc and PC CH4   |
| QA/QC procedures to be applied:  | This figure will be built into a spreadsheet for calculating emissions. The spreadsheet will be archived periodically and stored in two locations. Access to this figure will be controlled. |
| Any comment:   | No comment   |

|  |   |
|--|---|
| <b>Data / Parameter:</b>   | <b>GENy</b>   |
| Data unit:   | MWh   |
| Description:   | Electricity generated by the project,   |
| Source of data to be used:   | Electrical out meters on generators (sum of gross output from generators minus the power consumed at the plant)   |
| Value of data applied for the purpose of calculating expected emission reductions in section B.5 | In year 1, it is anticipated that a total of 5.1 MW of power generation capacity will be installed. In year two this will increase to 10.2 and in year 3 onwards, 12 MW<br>Assuming uptime of 7000 hours per year, this will equate to an estimated power generation of:<br>35,700 MWh in year 1<br>71,400 MWh in year 2; and<br>83,300 MWh in year 3 onwards |
| Description of measurement methods and procedures to be applied:                                 | Power generation will be metered on each generator and at the link from the generators to the grid. The priority measurement will be the cumulative net power exported meter. The secondary will derive from the sum of generator output less project site power use. The secondary data collection system will be  |



|                                 |   |
|---------------------------------|---|
|                                 | derived from the sum of the generator output less project site power use (measured and calculated for all plant at a normal load. It is a cumulative measurement and is therefore continuous.   |
| QA/QC procedures to be applied: | Calculations will be performed by spreadsheet which will be audited periodically and protected from being over-written or altered by unauthorized personnel. Data will be backed up and archived in two different locations, where it will be stored for the longer of two years longer than the crediting period or two years after the last issuance of CERs.<br>The net export meter will be approved by the local power company and calibrated and monitored in accordance with their instructions. |
| Any comment:                    | No comment  |

|  |                                       |
|--|---------------------------------------|
| <b>Data / Parameter:</b>   | <b>BE<sub>y</sub></b>                 |
| Data unit:   | T CO <sub>2</sub>                     |
| Description:   | Baseline emissions in year y          |
| Source of data to be used:   | Equals BE <sub>mr,y</sub> . See below |
| Value of data applied for the purpose of calculating expected emission reductions in section B.5 | See BE <sub>mr,y</sub> below          |
| Description of measurement methods and procedures to be applied:                                 | See BE <sub>mr,y</sub> below          |
| QA/QC procedures to be applied:  | See BE <sub>mr,y</sub> below          |
| Any comment:   | No comment                            |

|  |  |
|--|--|
| <b>Data / Parameter:</b>   | <b>BE<sub>mr,y</sub></b>   |
| Data unit:   | T CO <sub>2e</sub>   |
| Description:   | Baseline emissions from the release of methane to the atmosphere that is avoided by the project activity, in this case equal to the methane destroyed in MDelec. |
| Source of data to be used:   | MDelec   |
| Value of data applied for the purpose of calculating expected emission reductions in section B.5 | See MDelec above   |
| Description of measurement methods and procedures to be applied:                                 | See MDelec above   |



|                                 |                  |
|---------------------------------|------------------|
| QA/QC procedures to be applied: | See MDelec above |
| Any comment:                    | No comment       |

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|--|--|
| <b>Data / Parameter:</b>   | <b>HEATy</b>   |
| Data unit:   | GJ   |
| Description:   | Heat generated by the coal fired boilers which are displaced by heat produced by the project activity.   |
| Source of data to be used:   | Temperature and flow rates on outward and returning heating pipes  |
| Value of data applied for the purpose of calculating expected emission reductions in section B.5 | 55.188 GJ per year   |
| Description of measurement methods and procedures to be applied:                                 | Waste heat will be transferred from the generators to the mines ventilation, heater and building by way of closed circuit heat transfer system. The circuits will be fitted with constant flow pumps, thermocouples in the flow and return pipes and flow meters. Actual heat transferred will be determined by measuring the flow, inlet and return temperatures and logging the data. Measurements will be taken continuously and logged at nominal 30 second intervals. |
| QA/QC procedures to be applied:  | Temperature and flow rate data will be used to calculate heat supplied and this will be fed into a data logger for determination of heat supply. Heat will be supplied to meet demand which is determined by need for compliance with mine air temperature regulations and hence on ambient temperature which will also be recorded. Measurement equipment will be calibrated and monitored in accordance with manufacturer instruction.                                   |
| Any comment:   | No comment   |

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|--|--|
| <b>Data / Parameter:</b>   | <b>T</b>   |
| Data unit:   | Kelvin   |
| Description:   | Temperature of CMM   |
| Source of data to be used:   | Temperature sensor on gas pipework between the treatment unit and the generators   |
| Value of data applied for the purpose of calculating expected emission reductions in section B.5 | 293  |
| Description of measurement methods and procedures to be applied:                                 | Thermocouple or similar suitable device  |
| QA/QC procedures to be applied:  | Calibrated and monitored as per manufacturers' instructions. Logging of data and storage for 2 years after crediting lifetime. |
| Any comment:   | No comment   |



|  |   |
|--|---|
| <b>Data / Parameter:</b>   | <b>CONS<sub>ELEC-PJ</sub></b>   |
| Data unit:   | MWh   |
| Description:   | Additional power consumption by project activity  |
| Source of data to be used:   | N/A, since the project activity does not use any additional power when compared to the baseline |
| Value of data applied for the purpose of calculating expected emission reductions in section B.5 | Zero  |
| Description of measurement methods and procedures to be applied:                                 | N/A   |
| QA/QC procedures to be applied:  | N/A   |
| Any comment:   | No comment  |

|  |  |
|--|--|
| <b>Data / Parameter:</b>   | <b>EFF<sub>HEAT</sub></b>  |
| Data unit:   | Percentage   |
| Description:   | Efficiency of heat conversion in the baseline  |
| Source of data to be used:   | ACM0008 ver 3  |
| Value of data applied for the purpose of calculating expected emission reductions in section B.5 | 100 %  |
| Description of measurement methods and procedures to be applied:                                 | N/A. The approved methodology provides two different options. Option B is selected whereby the boilers are assumed to convert 100% of the heat value of the coal into heat for the mine air. This is a conservative assumption because no data on efficiency of conversion is available. |
| QA/QC procedures to be applied:  | None   |
| Any comment:   | No comment   |

|  |  |
|--|--|
| <b>Data / Parameter:</b>   | <b>MM<sub>i</sub></b>  |
| Data unit:   | tCH <sub>4</sub>   |
| Description:   | Methane measured sent to use i                                   |
| Source of data to be used:   | ACM0008 ver 3  |
| Value of data applied for the purpose of calculating expected emission reductions in section B.5 | 100 %  |
| Description of   | Flow meters will electronically record gas volumes, pressure and |





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|   |  |
|---|--|
| measurement methods and procedures to be applied: | temperature. Data will be stored for 2 years |
| QA/QC procedures to be applied:                   | None   |
| Any comment:                                      | No comment                                   |

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|--|--|
| <b>Data / Parameter:</b>   | <b>PMM<sub>pl,y</sub></b>  |
| Data unit:   | tCH <sub>4</sub>   |
| Description:   | Post-mining CMM captured, sent to and destroyed by use I in the project activity in year y |
| Source of data to be used:   | ACM0008 ver 3  |
| Value of data applied for the purpose of calculating expected emission reductions in section B.5 | 100 %  |
| Description of measurement methods and procedures to be applied:                                 | N/A  |
| QA/QC procedures to be applied:  | N/A  |
| Any comment:   | No comment   |

|  |  |
|--|--|
| <b>Data / Parameter:</b>   | <b>FVRG<sub>h</sub></b>  |
| Data unit:   | m <sup>3</sup> /h  |
| Description:   | volumetric flow rate of the residual gas at normal conditions in the hour h (residual gas to flare)  |
| Source of data to be used:   | Measured by project participants using a V-cone flow meter with +/-0.5% accuracy   |
| Value of data applied for the purpose of calculating expected emission reductions in section B.5 | N/A  |
| Description of measurement methods and procedures to be applied:                                 | Ensure that the same basis is considered for this measurement and the measurement of the volumetric fraction of all components in the residual gas when the residual gas temperature exceeds 60 Degree |
| QA/QC procedures to be applied:  | Flow meters are to be periodically calibrated according to the manufacturer's recommendation.  |
| Any comment:   | No comment   |



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|--|--|
| <b>Data / Parameter:</b>   | $f_{vi,h}$   |
| Data unit:   | -  |
| Description:   | Volumetric fraction of component $i$ in the residual gas in the hour $h$ where $i = CH_4, CO_2$  |
| Source of data to be used:   | Measurements by project participants using a continuous gas analyzer   |
| Value of data applied for the purpose of calculating expected emission reductions in section B.5 | Ensure that the same basis wet is considered for this measurement and the measurement of the volumetric flow rate of the residual gas ( $FVRG,h$ ) when the residual gas temperature exceeds 60 °C |
| Description of measurement methods and procedures to be applied:                                 | Continuously. Values to be averaged hourly time interval   |
| QA/QC procedures to be applied:  | Analyzers must be periodically calibrated according to the manufacturer's recommendation. A zero check and a typical value check should be performed by comparison with a standard certified gas.  |
| Any comment:   | As a simplified approach, project participants may only measure the Methane content of the residual gas and consider the remaining part as N <sub>2</sub> .  |

|  |   |
|--|---|
| <b>Data / Parameter:</b>   | $f_{v CH_4, RG, h}$   |
| Data unit:   | -   |
| Description:   | volumetric fraction of methane in the residual gas on dry basis in hour $h$   |
| Source of data to be used:   | Measured by project participants using a continuous gas analyzer  |
| Value of data applied for the purpose of calculating expected emission reductions in section B.5 | 50%   |
| Description of measurement methods and procedures to be applied:                                 | Ensure that the same basis is considered for this measurement and the measurement of the volumetric flow rate of the residual gas when the residual gas temperature exceeds 60 Degree             |
| QA/QC procedures to be applied:  | Analyzers must be periodically calibrates according to the manufacturer's recommendation. A zero check and a typical value check should be performed by comparison with a standard certified gas. |
| Any comment:   | As a simplified approach, project participants may only measure the methane content of the residual gas and consider the remaining part as N <sub>2</sub> .                                       |



|  |  |
|--|--|
| <b>Data / Parameter:</b>   | $T_{flare}$  |
| Data unit:   | °C   |
| Description:   | Temperature of the flue gas of the flare   |
| Source of data to be used:   | Temperature thermocouple   |
| Value of data applied for the purpose of calculating expected emission reductions in section B.5 | N/A  |
| Description of measurement methods and procedures to be applied:                                 | Monitored continuously by a Type N thermocouple. A temperature above 500 Degree indicates that a significant amount of gases are still being burnt and that the flares is operating.   |
| QA/QC procedures to be applied:  | Data will be backed up and archived where it will be stored for the longer of two years longer than the crediting period or two years after the last issuance of CERs. Thermocouple will be calibrated according to the manufacturer's specifications. |
| Any comment:   | N/A  |

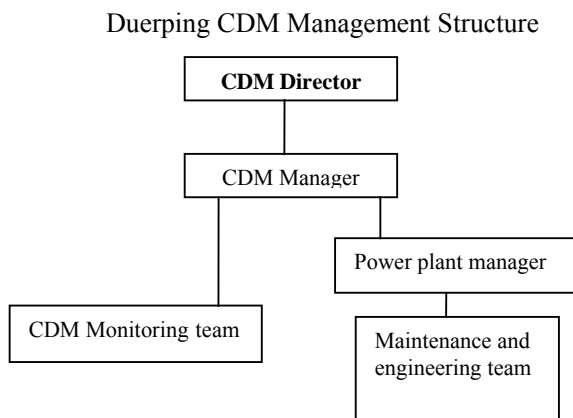
|  |  |
|--|--|
| <b>Data / Parameter:</b>   | <i>Manufacturer's specifications</i>   |
| Data unit:   | various  |
| Description:   | Certified specifications of equipment  |
| Source of data to be used:   | Commissioning reports, certificates and approval notices provided by manufacturers or suppliers  |
| Value of data applied for the purpose of calculating expected emission reductions in section B.5 | n/a  |
| Description of measurement methods and procedures to be applied:                                 | Periodic checking, monitoring or calibration of equipment according to the manufacturers specifications  |
| QA/QC procedures to be applied:  | Implementation of maintenance and calibrations schedules, with results (e.g. calibration certificates) to be stored for the longer of two years longer than the crediting period or two years after the last issuance of CERs. |
| Any comment:   | n/a  |

### **B.7.2 Description of the monitoring plan:**

A monitoring plan will be implemented to ensure that the approved monitoring methodology ACM0008 version 03 is correctly implemented in order to enable the accurate and transparent determination of avoided emissions. The plan will incorporate the QA/QC procedures described in 7.1 above.



**Scope:** This procedure covers the project activity described in the CDM project entitled Duerping Coal Mine Methane Project.



**Responsibility and CDM management:** A CDM manager will be appointed at Duerping mine with responsibility for monitoring all Project related activities and organising training. The CDM Project Manager is responsible for overseeing the implementation of this procedure. Competency requirements for the position of Project Manager will be defined and applied to ensure that the Project Manager is able to implement this procedure.

All calculations will be checked and signed off by the CDM monitoring manager who will also be responsible for preparing and checking documents required for verification.

A CDM monitoring team will report directly to the monitoring manager and who will have day to day responsibilities for checking instrumentation, record keeping, data handling and data processing, filing, reporting, organising repair and maintenance of monitoring equipment and ensuring the monitoring plan is adhered to as indicated in the approved PDD. The monitoring staff will receive technical training and refresher training as well as safety training to minimise exposure to workplace hazards. At least one fully trained technical member of the monitoring team will be present on every shift.

Operational staff with existing responsibilities for gas monitoring at the extraction plant will receive additional training and will collaborate with the monitoring staff. A management level link will be established to ensure effective co-operation between mine staff and CDM monitoring staff.

All relevant information, notes of meetings, data files, maintenance records, defect reports, hard copy and computerised records of monitoring will be kept at a designated location and arranged in an orderly and transparent manner to facilitate audit as and when required.

Responsibilities, procedures, methods, equipment types and specifications are described in detail in a site-specific CDM monitoring manual.

**On-line monitoring system:** All key meters required to determine GHG emissions and emission reductions will be monitored from a central control point which will record meter readings at a pre-



determined interval as specified in the CDM monitoring manual. These data will be used to continually update total emission reductions as long as the generating plants are in operation.

Key meters will measure parameters MMelec (volume of methane sent to generators), PC CH<sub>4</sub> (percentage methane by volume), temperature and pressure of the CMM at the flow meter and GEN<sub>y</sub> (electricity generated in year y) and heat transferred to the shaft air heater. Annual measurements of PCnmhc will also be undertaken.

Calculation of avoided emissions:

The data required for calculating baseline and project emissions will be fed into a processor (spreadsheet or logarithm application) which will calculate the emission reductions according to the formulae described above, using the defined default values. Access to the computer program will be controlled for security. The process will include various checks, such as a comparison of total methane consumed against total power generated and will be regularly audited to ensure it is operating correctly.

#### **Non essential data**

The on-line monitoring system will also record “non-essential” data. Such data is termed non-essential because it is not directly listed in the CDM Monitoring Methodology, but it will constitute a means of corroborating the on-line system. Non-essential data will include measurements of net and gross output from individual generators, certificated conversion efficiency, data from extraction plant, flow rate upstream of the vacuum pumps (can also be compared with name plate capacity of pumps, pump(s) operational and service history) and methane concentration in CMM at other points of the CMM system. Any subsequent CDM and non CDM utilisation/destruction additions to the gas supply circuit will be monitored.

#### **Accuracy and calibration of instruments**

All meters will be purchased and maintained as specified in the CDM monitoring manual to achieve an accuracy of  $\pm 5\%$  methane mass flow. All key meters will be subject to a quality control regime that will include regular maintenance and calibration. A record will be maintained showing the location and unique identification number of each meter, the calibration status of that meter (when last calibrated, when next due for calibration) and who performs the calibration service. Evidence of calibration will be retained for all meters until two years after the end of the crediting period.

Mass flow of methane supplied to the engines will be corroborated by comparison with the sum of the gross engine power outputs, the relationship being a function of engine efficiency which can be considered a constant under the proposed maintenance regime

#### **Archiving of data**

The on-line system will automatically archive data to a secure and retrievable storage format on a periodic e.g. weekly basis. Calibration records will be archived in an accessible electronic format. These data will be stored until 2 years after the end of the crediting period.

#### **Document Control**

The Project Manager will implement a document control system that ensures that the current versions of necessary documents are available at the point of use.

#### **Preparation of monitoring report**



The archived / live data will be used to prepare a periodic monitoring report to be submitted to the CDM EB for verification and issuance of CERs. A standard format for the monitoring report will be prepared and prior to the submission of the first monitoring report.

#### **Manual data recording system**

The Site Manager will implement a manual data recording system to act as a back-up for the on-line system. This will involve completion of a weekly log sheet. These log sheets will act as a back-up for mass volume combusted and a means of estimating other essential data in the event of a prolonged failure of the on-line system. Prolonged failure will constitute more than 24 hours (cumulative) without on-line monitoring.

#### **Treatment of missing or corrupted data**

Where data in the on-line system are corrupted or missing and no secondary data are available whilst the generators are operating (as shown, for example, by electricity output) the missing data can be estimated by taking the lower of the average value for the parameter in question in the hour before the error arose or the hour immediately after the system came on-line again. If there is evidence to suggest that both of these values are un-representative, the average from the previous 24 hours will be used.

The error will be recorded in the daily log sheet and the occurrence of the error will be investigated and rectified as soon as possible. If the on-line system is compromised for more than 24 hours, data will be manually recorded.

Any deficiencies in methane flow monitoring data will be rectified by back calculation from power generation data.

#### **Audit function and management review**

The Project Manager will arrange for an audit of the management system periodically and at least once per year. The auditor will not be involved in the daily operation of the mine and if necessary, may be sourced from a third party. The auditor will assess the implementation of the monitoring procedure and the preparation of the monitoring report. Audit findings, and steps taken to address findings will be recorded and reviewed in a Management Review meeting (convened at least annually) at which time the effectiveness of these procedures will be reviewed and necessary changes implemented.

|   |
|---|
| <b>B.8 Date of completion of the application of the baseline study and monitoring methodology and the name of the responsible person(s)/entity(ies)</b> |
|---|

26/06/2008.

The PDD was completed by Gareth Phillips, Chief Climate Change Officer, Sindicatum Carbon Capital (project developer) [gareth.phillips@carbon-capital.com](mailto:gareth.phillips@carbon-capital.com).

|   |
|---|
| <b>SECTION C. Duration of the project activity / crediting period</b> |
|---|

|  |
|--|
| <b>C.1 Duration of the project activity:</b> |
|--|

|  |
|--|
| <b>C.1.1. Starting date of the project activity:</b> |
|--|

19/03/2007 (Purchase of equipment)

**C.1.2. Expected operational lifetime of the project activity:**

10 years; the utilization scheme is expected to continue after the end of the designated crediting period for a substantial part of the anticipated remaining lifetime of the mine

**C.2 Choice of the crediting period and related information:****C.2.1. Renewable crediting period****C.2.1.1. Starting date of the first crediting period:**

N/A

**C.2.1.2. Length of the first crediting period:**

N/A

**C.2.2. Fixed crediting period:****C.2.2.1. Starting date:**

01/10/2008 or date of registration, which ever is later

**C.2.2.2. Length:**

10 years

**SECTION D. Environmental impacts****D.1. Documentation on the analysis of the environmental impacts, including transboundary impacts:**

Environmental impacts have been analyzed in the Feasibility Study number F2171K-A-01 prepared by the Xishan Electric Power Design Institute. The document concludes (on page 55) that “The suggested gas power plant is in compliance with the national policy of comprehensive utilization of resources and environmental protection.”

The revised feasibility study (to include the waste heat utilisation) has been completed and approved by local government. An EIA has been undertaken in accordance with regulations and has been approved by the EPB.

Under the law of environmental protection of China, analysis and assessment of environmental impacts created by this project have been carried out. Environmental Protection Bureau of Shanxi province has approved the implementation of the project on September 30th 2006 (Approval No.: [2006]396).

According to Environmental Impacts Report, the environmental impacts that are possible to be influenced by this project include:

**1. Noises**

First of all, project owner will use the type of equipments which are in line with national standard. Project owner also will take several measures to mitigate noises level produced during project period, like



enclosing the generators in noise proof containers. As for constructors, project owner will provide them with noise reduction equipments in line with national regulations.

## **2. Living Sewage**

Little amounts of waste water will be created as all water will be recycled by the coal mine for internal use. The generators have a closed circuit and any changes of water will be treated with maximum care and sent to the local sewage system for treatment. All the sewage that is discharged out will meet the requirement of “Sewage discharge standards” (GB8978-1996).

## **3. Air Pollution**

The generators and flares installed will not produce any pollutant emissions and energy in heat form will be produced from the destruction units.

## **4. Ecological Impact**

In order to reduce ecological impact, some measures are taken, like marking the construction area clearly, banning the activities of smoking, fire, hunting, fishing and so on. The power production plant will be situated around the coal mine to ensure that no vegetated area is disturbed due to the project.

**D.2. If environmental impacts are considered significant by the project participants or the host Party, please provide conclusions and all references to support documentation of an environmental impact assessment undertaken in accordance with the procedures as required by the host Party:**

Environmental impacts are not considered significant by project participants or the host party.

## **SECTION E. Stakeholders' comments**

### **E.1. Brief description how comments by local stakeholders have been invited and compiled:**

A Stakeholder consultation meeting was convened at Duerping Coal Mine at 08.30 – 11.00, Monday 30<sup>th</sup> October 2006. 24 participants were invited from a list of stakeholders compiled by Shanxi Coking Coal in consultation with SCC. A notice was also displayed in the foyer of Duerping Coal Mine (see fig 3).

24 Participants took part in the meeting (see list of participants in Appendix 1). See Figs 4- 6 showing the meeting.

Questions from the participants and answers provided were recorded during the meeting.





Fig 1: Duerping Coal Mine



Fig 2: Duerping Coal Mine



Fig 3: Public announcement of meeting



Fig 4: Stakeholder consultation in process



Fig 5: Presentation of the project by (left to right) Sheng Jin Ming, Zhang Neng Hu and Wu Dong Sheng



Fig 6: Answering questions from villagers

#### **E.2. Summary of the comments received:**

In summary, all of the participants understood the objectives of the project were supportive of the project and urged all parties to implement the project as soon as possible. Cheng Shi Xin from Xin Hua Village asked that the project developers specifically ensure that land is used most efficiently and that no land is wasted, as land is the basis of the farmer's existence and there is not much farming land available. In response to this request, it was confirmed that the generators will be placed as close to each other as safety permits and that the total area occupied by the first batch of generators would not be much bigger than the room we were in.

In particular, the following questions were received and answers provided:

Q: What gases are coming from the mine and what will the project do to them?

A: Methane is the main gas, which has a global rather than local impact. The project will burn the methane, converting it to CO<sub>2</sub> and water vapour. Waste heat from the generators will be used to heat the mine intake air, removing the need to run two coal fired boilers, which will have a positive impact upon local air quality.

Q: How will the computers control the equipment?

A: The computers monitor the quality and quantity of methane coming from the mine and stop and start the generators accordingly.

Q: Will there be much noise?

A: No. Each generator will be enclosed within a sound proofed container. The noise levels will be well below the Chinese legislative requirements.

Q: So, the project will improve local air quality, not use much land, not make much noise?

A: Correct.

Q: Did Xishan buy the land or lease it?



A: Xishan has secured a long term land rental agreement for the land (999 year lease).

Q: Could the methane be used for cooking purposes?

A: Yes, in theory, but in practice, it would require a pipeline to be laid and varying qualities of methane might mean that the system was not always operating.

**E.3. Report on how due account was taken of any comments received:**

Care will be taken to ensure that no land is wasted.

**Annex 1****CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY**

|                  |   |
|------------------|---|
| Organization:    | Shanxi Coking Coal Group Company Ltd            |
| Street/P.O.Box:  | Room 1705 no1 Section 1 Xin Jin Si Rd           |
| Building:        |   |
| City:            | Taiyuan   |
| State/Region:    | Shanxi Province                                 |
| Postfix/ZIP:     |   |
| Country:         | China   |
| Telephone:       | +86 0351 8305170                                |
| FAX:             |   |
| E-Mail:          |   |
| URL:             |   |
| Represented by:  | Du Fuxin  |
| Title:           | Chairman, Shanxi Coking Coal Group Company Ltd. |
| Salutation:      | Mr.   |
| Last Name:       | Du  |
| Middle Name:     |   |
| First Name:      | Fuxin   |
| Department:      | Shanxi Jaimei Group                             |
| Mobile:          | +86 15935137988                                 |
| Direct FAX:      |   |
| Direct tel:      |   |
| Personal E-Mail: |   |

|                 |  |
|-----------------|--|
| Organization:   | Sindicatum Carbon Capital Ltd.   |
| Street/P.O.Box: | Hanover Square   |
| Building:       | 18   |
| City:           | London   |
| State/Region:   |  |
| Postfix/ZIP:    | W1S 1HX  |
| Country:        | UK   |
| Telephone:      | + 44 20 3008 4759  |
| FAX:            | +44 20 3008 4752   |
| E-Mail:         | <a href="mailto:Gareth.phillips@carbon-capital.com">Gareth.phillips@carbon-capital.com</a> |
| URL:            |  |
| Represented by: | Simon Zuanic   |
| Title:          | CEO SCC Asia   |
| Salutation:     | Mr   |
| Last Name:      | Zuanic   |
| Middle Name:    |  |
| First Name:     | Simon  |



**CDM – Executive Board**

|                  |  |
|------------------|--|
| Department:      |  |
| Mobile:          |  |
| Direct FAX:      |  |
| Direct tel:      |  |
| Personal E-Mail: |  |



Annex 2

**INFORMATION REGARDING PUBLIC FUNDING**

No public funding is utilized.



**Annex 3**

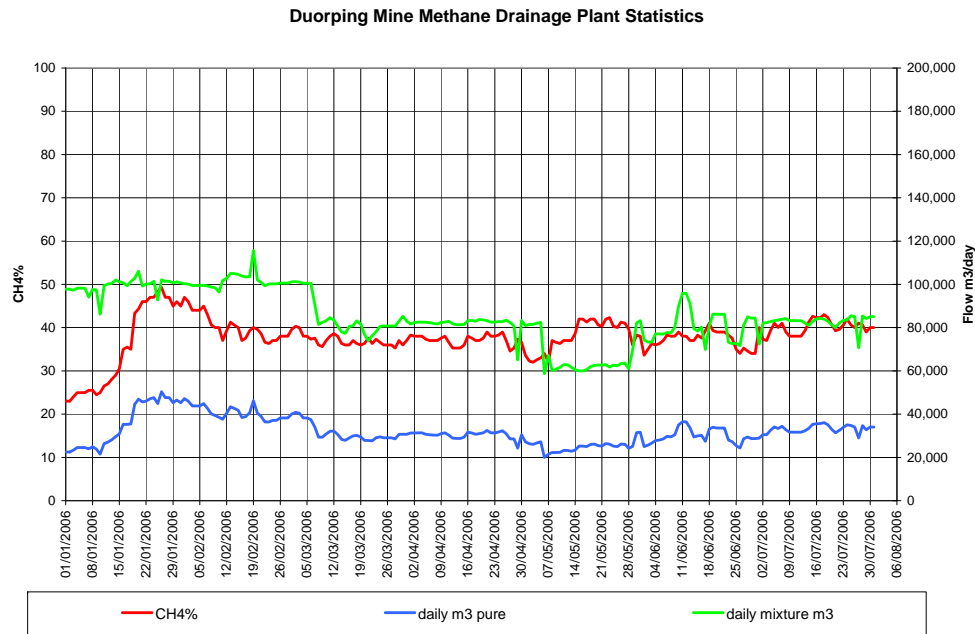
**BASELINE INFORMATION**

**Coal Production**

| Year         | Coal production (Mt/year) |
|--------------|---------------------------|
| 2000         | 2.8                       |
| 2001         | 2.7                       |
| 2002         | 3.6                       |
| 2003         | 3.9                       |
| 2004         | 4.5                       |
| 2005         | 4.5                       |
| 2006         | 4.3                       |
| 2007 onwards | 5.0                       |



### Data on coal mine methane emissions over a 9 month period







## Grid emission factor

## Calculation of OM information

Table A3-1. Calculation of simple OM emission factor of North China Power Grid in 2003

| Fuels             | Units         | Beijing | Tianjin | Hebei   | Shanxi | Inner Mongolia | Shandong | Total       | Emission factor | OXID | NCV                     | Emission (tCO <sub>2</sub> e)         |
|-------------------|---------------|---------|---------|---------|--------|----------------|----------|-------------|-----------------|------|-------------------------|---------------------------------------|
|                   |               |         |         |         |        |                |          |             | (tC/TJ)         | (%)  | (MJ/t,km <sup>3</sup> ) | $K=G*H*I*J*44/12/1000$<br>(in mass)   |
|                   |               | A       | B       | C       | D      | E              | F        | G=A+B+...+F | H               | I    | J                       | $K=G*H*I*J*44/12/1000$<br>(in volume) |
| Raw coal          | 10,000 tonnes | 714.73  | 1052.74 | 5482.64 | 4528.5 | 3949.32        | 6808     | 22535.94    | 25.8            | 100  | 20908                   | 445737636.11                          |
| Washed coal       | 10,000 tonnes |         |         |         |        |                | 9.41     | 9.41        | 25.8            | 100  | 26344                   | 234510.60                             |
| Other washed coal | 10,000 tonnes | 6.31    |         | 67.28   | 208.21 |                | 450.9    | 732.7       | 25.8            | 100  | 8363                    | 5796681.31                            |
| Coke              | 10,000 tonnes |         |         |         |        | 2.8            |          | 2.8         | 25.8            | 100  | 28435                   | 75318.63                              |
| Coke oven gas     | 0.1billion m3 | 0.24    | 1.71    |         | 0.9    | 0.21           | 0.02     | 3.08        | 12.1            | 100  | 16726                   | 228559.67                             |
| Other gas         | 0.1billion m3 | 16.92   |         | 10.63   |        | 10.32          | 1.56     | 39.43       | 12.1            | 100  | 5227                    | 914399.71                             |
| Crude oil         | 10,000 tonnes |         |         |         |        |                | 29.68    | 29.68       | 20              | 100  | 41816                   | 910139.18                             |
| Gasoline          | 10,000 tonnes |         |         |         |        |                | 0.01     | 0.01        | 18.9            | 100  | 43070                   | 298.48                                |
| Diesel            | 10,000 tonnes | 0.29    | 1.35    | 4       |        | 2.91           | 5.4      | 13.95       | 20.2            | 100  | 42652                   | 440693.26                             |
| Fuel oil          | 10,000 tonnes | 13.95   | 0.02    | 1.11    |        | 0.65           | 10.07    | 25.8        | 21.1            | 100  | 41816                   | 834672.45                             |



|                          |               |      |  |      |  |  |       |       |      |     |          |           |
|--------------------------|---------------|------|--|------|--|--|-------|-------|------|-----|----------|-----------|
| LPG                      | 10,000 tonnes |      |  |      |  |  |       | 0     | 17.2 | 100 | 50179    | 0.00      |
| Refinery gas             | 10,000 tonnes |      |  | 0.27 |  |  | 0.83  | 1.1   | 18.2 | 100 | 46055    | 33807.44  |
| Natural gas              | 0.1billion m3 |      |  | 0.5  |  |  | 1.08  | 1.58  | 15.3 | 100 | 38931    | 345076.60 |
| Other petroleum products | 10,000 tonnes |      |  |      |  |  |       | 0     | 20   | 100 | 38369    | 0.00      |
| Other coking products    | 10,000 tonnes |      |  |      |  |  |       | 0     | 25.8 | 100 | 28435    | 0.00      |
| Other energy             | 10,000 tCe    | 9.83 |  |      |  |  | 39.21 | 49.04 | 0    | 100 | 0        | 0.00      |
|                          |               |      |  |      |  |  |       |       |      |     | Subtotal | 45555179  |

Data source: China Energy Statistical Yearbook 2004.

**Table A3-2. The amount of electricity generated by thermal power plant in North China Power Grid in 2003**

| Province       | The amount of electricity generated<br>(MWh) | The proportion of electricity consumed by the project<br>(%) | The amount of electricity delivered<br>(MWh) |
|----------------|--|--|--|
| Beijing        | 18608000                                     | 7.52   | 17208678.4                                   |
| Tianjin        | 32191000                                     | 6.79   | 30005231.1                                   |
| Hebei          | 108261000                                    | 6.5  | 101224035                                    |
| Shanxi         | 93962000                                     | 7.69   | 86736322.2                                   |
| Inner Mongolia | 65106000                                     | 7.66   | 60118880.4                                   |
| Shandong       | 139547000                                    | 6.79   | 130071759                                    |
| <b>Total</b>   |  |  | 425364906                                    |

Data source: China Electric Power Yearbook 2004

**Table A3-3. Calculation of simple OM of North China Power Grid in 2003**

|   |           |
|---|-----------|
| The Net electricity Amount imported from North China Power Grid (MWh)       | 4,244,380 |
| Average emission factor for North China Power Grid (tCO <sub>2</sub> e/MWh) | 1.13656   |



|  |             |
|--|-------------|
| <b>Total CO2 emission of North China Power Grid (tCO<sub>2</sub>e)</b>       | 460,375,781 |
| <b>Total amount of electricity delivered by North China Power Grid (MWh)</b> | 429,609,286 |
| <b>Simple OM of North China Power Grid (tCO<sub>2</sub>e/MWh)</b>            | 1.071615    |



**Table A3-4. Calculation of simple OM emission factor of North China Power Grid in 2004**

| Fuels             | Units         | Beijing | Tianjin | Hebei  | Shanxi | Inner Mongolia | Shandong | Total       | Emission factor | OXID | NCV                     | Emission (tCO <sub>2</sub> e)         |
|-------------------|---------------|---------|---------|--------|--------|----------------|----------|-------------|-----------------|------|-------------------------|---------------------------------------|
|                   |               |         |         |        |        |                |          |             | (tC/TJ)         | (%)  | (MJ/t,km <sup>3</sup> ) | $K=G*H*I*J*44/12/1000$<br>(in mass)   |
|                   |               | A       | B       | C      | D      | E              | F        | G=A+B+...+F | H               | I    | J                       | $K=G*H*I*J*44/12/1000$<br>(in volume) |
| Raw coal          | 10,000 tonnes | 823.09  | 1410    | 6299.8 | 5213.2 | 4932.2         | 8550     | 27228.29    | 25.8            | 100  | 20908                   | 538547476.6                           |
| Washed coal       | 10,000 tonnes |         |         |        |        |                | 40       | 40          | 25.8            | 100  | 26344                   | 996856.96                             |
| Other washed coal | 10,000 tonnes | 6.48    |         | 101.04 | 354.17 |                | 284.22   | 745.91      | 25.8            | 100  | 8363                    | 5901190.882                           |
| Coke              | 10,000 tonnes |         |         |        |        | 0.22           |          | 0.22        | 25.8            | 100  | 28435                   | 5917.8922                             |
| Coke oven gas     | 0.1billion m3 | 0.55    |         | 0.54   | 5.32   | 0.4            | 8.73     | 15.54       | 12.1            | 100  | 16726                   | 1153187.451                           |
| Other gas         | 0.1billion m3 | 17.74   |         | 24.25  | 8.2    | 16.47          | 1.41     | 68.07       | 12.1            | 100  | 5227                    | 1578574.385                           |
| Crude oil         | 10,000 tonnes |         |         |        |        |                |          | 0           | 20              | 100  | 41816                   | 0                                     |
| Gasoline          | 10,000 tonnes |         |         |        |        |                |          |             | 18.9            | 100  | 43070                   | 0                                     |
| Diesel            | 10,000 tonnes | 0.39    | 0.84    | 4.66   |        |                |          | 5.89        | 20.2            | 100  | 42652                   | 186070.4874                           |
| Fuel oil          | 10,000 tonnes | 14.66   |         | 0.16   |        |                |          | 14.82       | 21.1            | 100  | 41816                   | 479451.3838                           |
| LPG               | 10,000 tonnes |         |         |        |        |                |          | 0           | 17.2            | 100  | 50179                   | 0                                     |
| Refinery gas      | 10,000 tonnes |         | 0.55    | 1.42   |        |                |          | 1.97        | 18.2            | 100  | 46055                   | 60546.05223                           |
| Natural gas       | 0.1billion    |         | 0.37    |        | 0.19   |                |          | 0.56        | 15.3            | 100  | 38931                   | 122305.6296                           |



|                          |               |      |  |       |        |      |  |        |      |     |          |   |         |
|--------------------------|---------------|------|--|-------|--------|------|--|--------|------|-----|----------|---|---------|
|                          | m3            |      |  |       |        |      |  |        |      |     |          |   |         |
| Other petroleum products | 10,000 tonnes |      |  |       |        |      |  | 0      | 20   | 100 | 38369    | 0 |         |
| Other coking products    | 10,000 tonnes |      |  |       |        |      |  | 0      | 25.8 | 100 | 28435    | 0 |         |
| Other energy             | 10,000 tCe    | 9.41 |  | 34.64 | 109.73 | 4.48 |  | 158.26 | 0    | 100 | 0        | 0 |         |
|                          |               |      |  |       |        |      |  |        |      |     | Subtotal |   | 5490315 |

Data source: China Energy Statistical Yearbook 2005.

**Table A3-5. The amount of electricity of North China Power Grid generated by thermal power plants in 2004**

| Province       | The amount of electricity generated<br>(MWh) | The proportion of electricity consumed by the project<br>(%) | The amount of electricity delivered<br>(MWh) |
|----------------|--|--|--|
| Beijing        | 18579000                                     | 7.94   | 17,103,827                                   |
| Tianjin        | 33952000                                     | 6.35   | 31,796,048                                   |
| Hebei          | 124970000                                    | 6.5  | 116,846,950                                  |
| Shanxi         | 104926000                                    | 7.7  | 96,846,698                                   |
| Inner Mongolia | 80427000                                     | 7.17   | 74,660,384                                   |
| Shandong       | 163918000                                    | 7.32   | 151,919,202                                  |
| <b>Total</b>   |  |  | 489,173,110                                  |

Data source: China Electric Power Yearbook 2005

**Table A3-6. Calculation of simple OM of North China Power Grid in 2004**

|   |             |
|---|-------------|
| The Net electricity amount imported from North China Power Grid (MWh)         | 4,514,550   |
| Average emission factor for North China Power Grid (tCO <sub>2</sub> e/MWh)   | 1.17411     |
| Total CO <sub>2</sub> emission of North China Power Grid (tCO <sub>2</sub> e) | 554,332,148 |
| Total amount of electricity delivered by North China Power Grid (MWh)         | 493,687,660 |
| Simple OM of North China Power Grid (tCO <sub>2</sub> e/MWh)                  | 1.122840    |



Table A3-7. Calculation of simple OM emission factor of North China Power Grid in 2005

| Fuels             | Units         | Beijing | Tianjin | Hebei  | Shanxi | Inner Mongolia | Shandong | Total       | Emission factor | OXID | NCV                     | Emission (tCO <sub>2</sub> e)         |
|-------------------|---------------|---------|---------|--------|--------|----------------|----------|-------------|-----------------|------|-------------------------|---------------------------------------|
|                   |               |         |         |        |        |                |          |             | (tC/TJ)         | (%)  | (MJ/t,km <sup>3</sup> ) | $K=G*H*I*J*44/12/1000$<br>(in mass)   |
|                   |               | A       | B       | C      | D      | E              | F        | G=A+B+...+F | H               | I    | J                       | $K=G*H*I*J*44/12/1000$<br>(in volume) |
| Raw coal          | 10,000 tonnes | 897.75  | 1675.2  | 6726.5 | 6176.5 | 6277.23        | 10405.4  | 32158.53    | 25.8            | 100  | 20908                   | 636062535.8                           |
| Washed coal       | 10,000 tonnes |         |         |        |        |                | 42.18    | 42.18       | 25.8            | 100  | 26344                   | 1051185.664                           |
| Other washed coal | 10,000 tonnes | 6.57    |         | 167.45 | 373.65 |                | 108.69   | 656.36      | 25.8            | 100  | 8363                    | 5192725.191                           |
| Coke              | 10,000 tonnes |         |         |        |        | 0.21           | 0.11     | 0.32        | 25.8            | 100  | 28435                   | 8607.8432                             |
| Coke oven gas     | 0.1billion m3 | 0.64    | 0.75    | 0.62   | 21.08  | 0.39           |          | 23.48       | 12.1            | 100  | 16726                   | 1742396.483                           |
| Other gas         | 0.1billion m3 | 16.09   | 7.86    | 38.83  | 9.88   | 18.37          |          | 91.03       | 12.1            | 100  | 5227                    | 2111027.27                            |
| Crude oil         | 10,000 tonnes |         |         |        |        | 0.73           |          | 0.73        | 20              | 100  | 41816                   | 22385.49867                           |
| Gasoline          | 10,000 tonnes |         |         | 0.01   |        |                |          | 0.01        | 18.9            | 100  | 43070                   | 298.4751                              |
| Diesel            | 10,000 tonnes | 0.48    |         | 3.54   |        | 0.12           |          | 4.14        | 20.2            | 100  | 42652                   | 130786.3867                           |
| Fuel oil          | 10,000 tonnes | 12.25   |         | 0.23   |        | 0.06           |          | 12.54       | 21.1            | 100  | 41816                   | 405689.6325                           |
| LPG               | 10,000 tonnes |         |         |        |        |                |          | 0           | 17.2            | 100  | 50179                   | 0                                     |
| Refinery gas      | 10,000 tonnes |         |         | 9.02   |        |                |          | 9.02        | 18.2            | 100  | 46055                   | 277221.0107                           |
| Natural gas       | 0.1billion    | 0.28    | 0.08    |        | 2.76   |                |          | 3.12        | 15.3            | 100  | 38931                   | 681417.0792                           |



|                          |               |      |  |       |       |      |       |        |      |     |          |         |  |
|--------------------------|---------------|------|--|-------|-------|------|-------|--------|------|-----|----------|---------|--|
|                          | m3            |      |  |       |       |      |       |        |      |     |          |         |  |
| Other petroleum products | 10,000 tonnes |      |  |       |       |      |       | 0      | 20   | 100 | 38369    | 0       |  |
| Other coking products    | 10,000 tonnes |      |  |       |       |      |       | 0      | 25.8 | 100 | 28435    | 0       |  |
| Other energy             | 10,000 tCe    | 8.58 |  | 32.35 | 69.31 | 7.27 | 118.9 | 236.41 | 0    | 100 | 0        | 0       |  |
|                          |               |      |  |       |       |      |       |        |      |     | Subtotal | 6476862 |  |

Data source: China Energy Statistical Yearbook 2006.



**Table A3-8. The amount of electricity of North China Power Grid generated by thermal power plants in 2005**

| Province       | The amount of electricity generated<br>(MWh) | The proportion of electricity consumed by the project<br>(%) | The amount of electricity delivered<br>(MWh) |
|----------------|--|--|--|
| Beijing        | 20880000                                     | 7.73   | 19,265,976                                   |
| Tianjin        | 36993000                                     | 6.63   | 34,540,364                                   |
| Hebei          | 134348000                                    | 6.57   | 125,521,336                                  |
| Shanxi         | 128785000                                    | 7.42   | 119,229,153                                  |
| Inner Mongolia | 92345000                                     | 7.01   | 85,871,616                                   |
| Shandong       | 189880000                                    | 7.14   | 176,322,568                                  |
| <b>Total</b>   |  |  | 560,751,013                                  |

Data source: China Electric Power Yearbook 2006

**Table A3-9 Calculation of simple OM of North China Power Grid in 2005**

|   |             |
|---|-------------|
| <b>The Net electricity amount imported from North China Power Grid (MWh)</b>      | 23,423,000  |
| <b>Average emission factor for North China Power Grid (tCO<sub>2</sub>e/MWh)</b>  | 1.1578      |
| <b>Total CO<sub>2</sub> emission of North China Power Grid (tCO<sub>2</sub>e)</b> | 674,805,425 |
| <b>Total amount of electricity delivered by North China Power Grid (MWh)</b>      | 584,174,013 |
| <b>Simple OM of North China Power Grid (tCO<sub>2</sub>e/MWh)</b>                 | 1.155145    |

The weighted average emission factor over three years is 1.1207601 tCO<sub>2</sub>/MWh.



**Calculation of BM emission factor**

Step1: Calculation the proportion of CO2 emissions from solid fuels, liquid fuels and gas fuels against the total emission

**Table A3-10. Pproportion of CO2 emissions from solid fuels, liquid fuels and gas fuels against the total emission**

| Fuels                        | Units         | Beijing  | Tianjin  | Hebei    | Shanxi   | Inner Mongolia | Shandong | Total              | Emission factor (tC/TJ) | OXID (%) | NCV (MJ/t,km <sup>3</sup> ) | Emission (tCO <sub>2</sub> e)           |
|------------------------------|---------------|----------|----------|----------|----------|----------------|----------|--------------------|-------------------------|----------|-----------------------------|---|
|                              |               | <b>A</b> | <b>B</b> | <b>C</b> | <b>D</b> | <b>E</b>       | <b>F</b> | <b>G=A+B+...+F</b> | <b>H</b>                | <b>I</b> | <b>J</b>                    | <b>K=G*H*I*J*44/12/1000 (in mass)</b>   |
|                              |               |          |          |          |          |                |          |                    |                         |          |                             | <b>K=G*H*I*J*44/12/1000 (in volume)</b> |
| Raw coal                     | 10,000 tonnes | 897.75   | 1675.2   | 6726.5   | 6176.5   | 6277.23        | 10405.4  | 32158.53           | 25.8                    | 100      | 20908                       | 636,062,536                             |
| Washed coal                  | 10,000 tonnes |          |          |          |          |                | 42.18    | 42.18              | 25.8                    | 100      | 26344                       | 1,051,186                               |
| Other washed coal            | 10,000 tonnes | 6.57     |          | 167.45   | 373.65   |                | 108.69   | 656.36             | 25.8                    | 100      | 8363                        | 5,192,725                               |
| Coke                         | 10,000 tonnes |          |          |          |          | 0.21           | 0.11     | 0.32               | 25.8                    | 100      | 28435                       | 8,608                                   |
| <b>Total of solid fuels</b>  |               |          |          |          |          |                |          |                    |                         |          |                             | <b>642,315,054</b>                      |
| Crude oil                    | 10,000 tonnes |          |          |          |          | 0.73           |          | 0.73               | 20                      | 100      | 41816                       | 22,386                                  |
| Gasoline                     | 10,000 tonnes |          |          | 0.01     |          |                |          | 0.01               | 18.9                    | 100      | 43070                       | 2,986                                   |
| Diesel                       | 10,000 tonnes | 0.48     |          | 3.54     |          | 0.12           |          | 4.14               | 20.2                    | 100      | 42652                       | 130,786                                 |
| Fuel oil                     | 10,000 tonnes | 12.25    |          | 0.23     |          | 0.06           |          | 12.54              | 21.1                    | 100      | 41816                       | 405,690                                 |
| Other petroleum products     | 10,000 tonnes |          |          |          |          |                |          | 0                  | 20                      | 100      | 38369                       | 0                                       |
| <b>Total of liquid fuels</b> |               |          |          |          |          |                |          |                    |                         |          |                             | <b>559,160</b>                          |
| Natural gas                  | 0.1billion m3 | 0.28     | 0.08     |          | 2.76     |                |          | 3.12               | 15.3                    | 100      | 38931                       | 681,417                                 |
| Coke oven gas                | 0.1billion m3 | 0.64     | 0.75     | 0.62     | 21.08    | 0.39           |          | 23.48              | 12.1                    | 100      | 16726                       | 1,742,396                               |
| Other gas                    | 0.1billion m3 | 16.09    | 7.86     | 38.83    | 9.88     | 18.37          |          | 91.03              | 12.1                    | 100      | 5227                        | 2,111,027                               |
| LPG                          | 10,000 tonnes |          |          |          |          |                |          | 0                  | 17.2                    | 100      | 50179                       | 0                                       |
| Refinery gas                 | 10,000 tonnes |          |          | 9.02     |          |                |          | 9.02               | 18.2                    | 100      | 46055                       | 277,221                                 |





|       |    |        |        |         |         |         |         |          |
|-------|----|--------|--------|---------|---------|---------|---------|----------|
| Total | MW | 4882.5 | 6178.9 | 23165.7 | 23029.8 | 19950.2 | 37413.4 | 114620.5 |
|-------|----|--------|--------|---------|---------|---------|---------|----------|

Data source : China Electric Power Yearbook 2006

**Table A3-13. Installed capacity of North China Power Grid in 2004**

| Installed capacity    | Unit | Beijing | Tianjin | Hebei   | Shanxi  | Inner Mongolia | Shandong | Total   |
|-----------------------|------|---------|---------|---------|---------|----------------|----------|---------|
| Thermal power         | MW   | 3458.5  | 6008.5  | 19932.7 | 17693.3 | 13641.5        | 32860.4  | 93594.9 |
| Hydro power           | MW   | 1055.9  | 5       | 783.8   | 787.3   | 567.9          | 50.8     | 3250.7  |
| Nuclear power         | MW   | 0       | 0       | 0       | 0       | 0              | 0        | 0       |
| Wind power and others | MW   | 0       | 0       | 13.5    | 0       | 111.7          | 12.3     | 137.5   |
| Total                 | MW   | 4514.4  | 6013.5  | 20730   | 18480.6 | 14321.2        | 32923.5  | 96983.2 |

Data source : China Electric Power Yearbook 2005

**Table A3-14. Installed capacity of North China Power Grid in 2003**

| Installed capacity    | Unit | Beijing | Tianjin | Hebei   | Shanxi  | Inner Mongolia | Shandong | Total   |
|-----------------------|------|---------|---------|---------|---------|----------------|----------|---------|
| Thermal power         | MW   | 3347.5  | 6008.5  | 17698.7 | 15035.8 | 11421.7        | 30494.4  | 84006.6 |
| Hydro power           | MW   | 1058.1  | 5       | 764.3   | 795.7   | 592.1          | 50.8     | 3266    |
| Nuclear power         | MW   | 0       | 0       | 0       | 0       | 0              | 0        | 0       |
| Wind power and others | MW   | 0       | 0       | 13.5    | 0       | 76.6           | 0        | 90.1    |
| Total                 | MW   | 4405.6  | 6013.5  | 18476.5 | 15831.5 | 12090.4        | 30545.2  | 87362.7 |

Data source : China Electric Power Yearbook 2004

**Table A3-15. Calculation of BM emission factor for North China Power Grid**

|                                  | Installed capacity in 2002 | Installed capacity in 2003 | Installed capacity in 2004 | Newly added installed capacity from 2002 till 2004 | Proportion against newly added installed capacity |
|----------------------------------|----------------------------|----------------------------|----------------------------|--|---|
|                                  | A                          | B                          | C                          | D=C-A  |   |
| Thermal power (MW)               | 84006.6                    | 93594.9                    | 111068.7                   | 27062.1  | 99.28%  |
| Hydro power (MW)                 | 3266.0                     | 3250.7                     | 3216.2                     | -49.8  | -0.18%  |
| Nuclear power (MW)               | 0                          | 0                          | 0                          | 0  | 0.00%   |
| Wind power (MW)                  | 90.1                       | 137.5                      | 335.5                      | 245.4  | 0.90%   |
| Total (MW)                       | 87362.7                    | 96983.1                    | 114620.4                   | 27257.7  | 100.00%   |
| Share in 2004 installed capacity | 76.22%                     | 84.61%                     | 100%                       |  |   |

$$EF_{BM, y} = 0.9465 \times 99.28\% = 0.9397 \text{ tCO}_2/\text{MWh}.$$

Heat displacement: Calculated using Option B, assuming 100% efficient heat transfer

### 3. Emission Reductions achieved from displacing the in intake air heating boilers

- 2 Number of boilers
  - 2.1 Capacity of each boiler in MW
  - 4.2 Total capacity of boilers in MW
- 8760 h/year
- 13,140,000 Number of operating seconds of the boilers during 5 winter months (lower range of operating time)
- 55,188,000 Amount of MJ of energy output generated by the boilers



|        |   |
|--------|---|
| 55,188 | Amount of GJ of energy output generated by the boilers<br>(1/1000)        |
| 0.094  | T CO <sub>2</sub> per GJ of energy output                                 |
| 5,188  | Tonnes of CO <sub>2</sub> emitted by the coal fired boilers in due course |



#### Annex 4

### MONITORING INFORMATION

Monitoring will be undertaken as outlined in Section B7.2 and the operational details are described in a CDM monitoring manual specifically developed for the project and which will be made available to the validator.

The locations of methane flow monitoring to the CMM utilisation plant are shown in the Schematic below. Monitoring of the waste heat supply from the engines to the shaft heater has been excluded from the diagram for clarity.

